amateur radio

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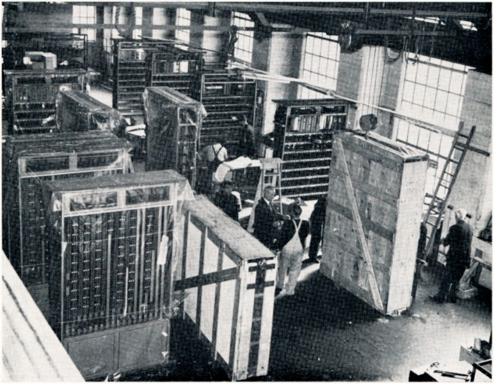

amateur radio

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Vol. 39, No. 8

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CONTENTS

COVER STORY

Industry, as well as Radio Amateurs, uses relays for switching purposes. Here 22 relay racks are being pre-wired for signalling of Melbourne railway yard. Each rack holds 231 transistor radio size relays.
(Block by courtesy of V.R.)

FEDERAL COMMENT:

AN OPEN REPLY TO AN ANONYMOUS LETTER

"Michael Owen, VK3KI,

Dear Sir,

Having perused Ron's (VK3RN) correspondence item in the July issue of 'Amateur Radio,' I can only fully agree with his findings.

The Institute is seeking an increase in membership—that is the impression I get from the various articles I read. My personal advice is, you are not seeking in the right area. There are many who would join the organisation if it would at least attempt to try to do something for them. I have spoken with Limited licensees on the question of the W.I.A., but they have said that they would not join. They feel that the Institute serves only one class, and that it has done nothing towards fighting for better frequency allocations for them.

The Institute has now worsened their image in their sight, in as much that you are willing in principal to allow an unskilled Novice on the h.f. bands, and the Limited licensee well knows of your opposition towards his gaining a little extra. If these people were allowed to operate on some of the h.f. bands it might liven it up a bit, because they are quite dead at the moment. As far as I am concerned these people in most cases are more than technically qualified—the greater percentage being employed in the electronic industry as engineers and advanced technicians.

Close your eyes if you dare—but let me warn you that it is in danger of starting an organisation* totally divorced from you, then it will be too late for you to make amends.

—A VERY FULL-UP CALL

*This could [be] closer than realised."

Dear Mr. Anonymous Letter Writer,

Unfortunately, as you did not put your name or address on your letter, I cannot reply to you personally. However, as I think you have raised some important issues, I think that it is proper to reply to your letter through this magazine. I hope that you do not mind.

At the outset, I would like to thank you for your interest in writing to me expressing your opinion. I think that is very good; it is really what the Institute is all about. It's task is to represent the Amateur Service in our country and obviously it can't do this without knowing what Amateurs think. Of course I think I should also point out that the anonymous letter is usually the least effective way of expressing views.

Having said that, may I join issue with you, Mr. Anonymous Letter Writer, on a number of things that you say in your letter as I am afraid that you have been misinformed on a number of points.

You are right, of course, when you say that the Institute seeks an increase in membership. The higher the percentage of licensees that are members of the Institute, the more representative the organisation is of the Amateur Service and, at the same time, the more effective can be its representation. That is why I think that it is in all our interests for as many Amateurs as possible to be members of the Institute.

But then you go on to say that you have spoken to many Limited licensees but that they feel that the Institute represents only one class of licence and has done nothing towards fighting for better frequency allocations for them. Your comment really surprises me. As I was a Limited licensee myself for ten years prior to 1967, I have always had a particular interest in the v.h.f. spectrum.

Mr. Anonymous Letter Writer, you seem to have overlooked the fact that the Limited licence was only introduced because of the representations of the Institute. You also overlooked the fact that a major portion of the Federal Council and Federal Executive's time in the last two years has been devoted to the International Telecommunications Union Space Conference which, as I write to you, is now in session in Geneva. This Conference is of great interest to the v.h.f. operator and it is possible that it could substantially affect his operating rights and privileges. You overlook also, that as a result of what the Institute has done, our country is one of the countries at this Conference that has taken up the cause of the Amateur Service. You also overlook the fact that as a member of the Region 3 Association (which, incidentally, was formed as a result of the initiative of the Institute in 1968) the Institute is a substantial contributor to the costs of sending a representative, Tom Clarkson, ZL2AZ, of New Zealand, to Geneva as a member of the International Amateur Radio Union Observer team. There, he is our special representative at the Space Conference.

You asked for "better frequency allocations". Yes, I know all about the 6 metre band—you cannot win them all. But really, are you serious in seeking more v.h.f. spectrum? I have not noticed an overcrowding problem on either the 144-148 MHz. allocation or the 420-450 MHz. allocation. Have you? I am not sure that your letter makes your complaint completely clear.

I think you really mean that Limited licensees should be permitted to operate on bands below 52 MHz. Many people will agree with you, but I rather think that more will disagree with you. Of course, if you are a member of the Institute, it is open to you to attempt to persuade the other members of the Institute to adopt a long term policy in relation to the Morse qualification requirement.

But, of course, the simple fact is that this is not just a matter for the Australian Post Office. Australia, as a member of the International Telecommunications Union, is bound by the I.T.U. Convention, an international agreement between countries. That agreement specifies that a Morse qualification is required for Amateurs licensed to operate below 144 MHz., though in fact in Australia, this qualification is only required below 52 MHz.

I am afraid that you have completely misconceived the present position in relation to Novice licensing. You also seem to think that I am personally "pushing" the Novice licence proposals. I am not. Neither I nor the Federal Executive have expressed any view at all on this matter. The policy of the Institute at this time is not to advocate the issue of a Novice type licence, but the Institute is having another look at this policy. The Federal Council has sought a report from a committee formed for the purpose and the Divisions are now seeking the views of members generally. That is the reason that I am not expressing any view on the question of a Novice licence. As Federal President, I feel that on this matter I should not, in any way, attempt to influence members to my particular view at this time.

If, Mr. Anonymous Letter Writer, you are a member (and you do not make this clear), then you **can** and I suggest **should**, take part in Institute affairs by expressing your view. As I said at the outset, that is what the Institute is all about. I agree with you that we do need more Amateurs on the h.f. bands. I think we need more Amateurs on all bands, but I believe that the Institute has to be realistic. We cannot, even if we want to (and I do not suggest that we do), just go and change the International Regulations. The Institute can, however, make it easier and more attractive for the Limited licensee to obtain a full licence. Do you remember, Mr. Anonymous Letter Writer, that the Morse code speed used to be 14 words per minute? It was the Institute that successfully sought a reduction of this speed to 10 words per minute.

No, Mr. Anonymous Letter Writer, I do not think that neither I nor the Institute has to make amends to the Limited licensees. We are not perfect and certainly we cannot expect all our members to be in agreement on every issue all the time, but I do think that the Limited licensee has no basis for thinking the Institute is not representing him.

Indeed, it may well be that the thinking Limited licensee, who knows the real facts, could conclude that he should be a member of the Institute because of what it is now doing for him and because, perhaps, it could do even more, given more support by Limited licensees.

Yours sincerely,

Michael J. Owen, VK3KI,

Federal President.

ANGLE MODULATION

LECTURE No. 14B

C. A. CULLINAN,* VK3AXU

Using sine waves, it is possible to illustrate the differences between amplitude, frequency and phase, and this has been done in Fig. 1.

Fig. 1a shows a single sine wave at three different amplitudes.

Fig. 1b shows three sine waves of the same amplitude and phase, but differing in frequency.

Fig. 1c shows three sine waves of the same frequency and amplitude, but differing in phase.

These three figures should be studied closely.

FREQUENCY MODULATION

When using an audio frequency voltage to produce f.m. it is the amplitude of the voltage which causes the carrier frequency to shift or deviate symmetrically from its assigned frequency pre-emphasis of 75 micro-seconds. However, in Australia for television sound the maximum deviation is ±50 KHz. and audio frequency pre-emphasis of 50 micro-seconds.

In the U.S.A. for f.m. broadcast stations the maximum deviation is ±75 KHz., and audio frequency pre-emphasis of 75 micro-seconds, however for television sound the maximum deviation is ±25 KHz. with an audio frequency pre-emphasis of 75 micro-seconds.

Digressing for a moment; in the Australian mobile radio-telephone services in the frequency bands 70-85 MHz. and 156-174 MHz., as from 30th June, 1969, the maximum deviation permitted for angle modulated stations has been ±5 KHz. (International maritime mobile u.h.f. radio-telephone and existing P.M.G. subscriber services were excluded.) The reduction of deviation to ±5 KHz. was made to enable 30 KHz. channeling of mobile stations so that more "speech" type stations could be accommodated in the available spectrum space. However, in January 1970 the demand for f.m. mobile services was becoming so great that stations in the same area had to share a common carrier frequency.

It is proposed to use the Australian standards in the remainder of this lecture to avoid confusion. This means that the loudest passage of, say, a musical concert would cause the carrier to deviate ±50 KHz. Thus the maximum applied audio frequency modulating voltage produces the maximum **frequency** deviation of the carrier whilst the carrier amplitude remains constant.

This is in direct contrast to amplitude modulation where the carrier frequency remains constant but the amplitude varies.

Thus if one of the sine waves shown in Fig. 1a was applied simultaneously to an f.m. transmitter and an a.m. one it would produce a certain amount of frequency deviation in the f.m. transmitter and a certain amount of amplitude variation in the a.m. transmitter. Then each of these characteristics would be varied if either of the other waves of Fig. 1a was to be substituted.

* 6 Adrian Street, Colac, Vic., 3250.

● Continuing the series of lectures by C. A. Cullinan, VK3AXU, at Broadcast Station 3CS for students studying for a P.M.G. Radio Operator's Certificate.

Furthermore, it must be realised that in an f.m. transmitter the frequency deviation depends entirely on the amplitude of the modulating wave, not on its frequency, thus if we take two frequencies at random, say 200 Hz. and 3,000 Hz., the **carrier frequency deviation** depends on the **amplitudes** of these frequencies.

Now in speech, music and sounds produced in nature, it is almost impossible to find a sustained sine wave, as almost all sounds are made up of many waves and produce complex waves. Our radio and television receivers recover such complex waveforms from the transmitted signal and the loudspeaker converts this into the motion of particles of the air, to produce sound waves which our ears can register and understand.

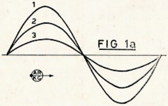
However, so far in this discussion of f.m. we have described only the manner in which an audio frequency voltage, sine wave or complex, causes deviation of the carrier frequency and this, on its own, would not enable intelligent signals to be transmitted as we must recover, in our receivers, the frequency components of the modulating wave.

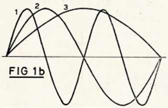
Therefore, in an f.m. transmitter the rate or frequency with which the deviation takes place is determined by the frequency of the modulating voltage. Referring back to our previous example, let us assume that both the 200 Hz. and the 3,000 Hz. waves are at the same amplitude, then each, if applied separately, will produce the same amount of deviation, but in the first case the **rate of deviation** will be 200 times per second and in the second case it will be 3,000 times per second.

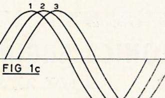
In the receiver the rate of deviation is recovered as the various audio frequencies and the deviation is recovered as the amplitude or volume level of the signal.

In Fig. 2a we see an audio frequency voltage in the form of a single sine wave applied to an f.m. transmitter operating at 100 MHz. and of sufficient amplitude to produce 10% deviation. It will be observed that the carrier frequency varies above and below its unmodulated value of 100 MHz. by an amount which is directly proportional to the amplitude of the modulating voltage; in this case ±5 KHz.

The frequency deviation is known as f_D, and as mentioned earlier, its maximum excursion is 50 KHz. This does not mean that the total bandwidth for full modulation is 100 KHz., but is the value of twice the modulating frequency







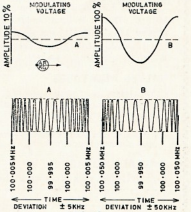


FIG. 2

Fig. 2 is not drawn for any particular audio frequency. Therefore if the audio frequency is, say, 100 Hz. then time is 1/100th second, for 1,000 Hz. time is 1/1,000th second, and for, say, 15 KHz. time is 1/15,000th second.

Fig. 2 shows that the deviation is entirely dependent on the amplitude of the modulating voltage, not on frequency.

It is the frequency of the modulating voltage which governs the rate at which the deviation takes place.

Modulation index equals deviation of f.m. carrier divided by audio frequency producing this deviation.

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To the list of Transceivers, available at reduced prices, are to be added two products of K.W. ELECTRONICS LTD. of England. Solidly built sets, as to be expected from British manufacture, the ATLANTA five-band Transceiver (a copy of the SWAN 500) and the KW2000B (which is built along the lines of the Collins KWM2), similar in appearance with the 160 metre band added—the only Transceiver with that band covered! Both sets will arrive in August with their own AC power supply-speaker units, but in limited quantities. The same applies to the YAESU MUSEN Transceivers listed, so better hurry to profit from the special offers and low prices.

—Arie Bles

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plus double the deviation; i.e. if a modulation frequency of 15 KHz. is applied to give full frequency deviation, then the bandwidth will be $(2 \times 15) + (2 \times 50) = 130$ KHz. This is shown in Fig. 2b which illustrates an audio frequency modulating voltage producing a deviation of ± 50 KHz.

Note that Figs. 2a. and 2b are not drawn to the same scale, as 2b would be ten times the size of 2a if drawn to the same scale.

The centre frequency of 100 MHz. has been used for ease in explanation. In Australia there would not be any angle modulated transmitter on this frequency, the nearest to it being the sound transmitter of television channel 4 where the centre frequency is 100.75 MHz.

The effect of an inductance on an alternating current is to cause the current to lag 90° behind the voltage and the amount of the current will be dependent on the frequency of the voltage, the amplitude of the voltage and the amount of the inductance. Should the frequency be held constant then there will be an increase of current as the inductance is decreased.

This may be restated by saying that if the inductance is held constant, then the current will increase as the frequency decreases. Mathematically this may be expressed as: $I = E \div (2\pi fL)$.

It will be remembered from Ohm's Law that when two resistances are connected in parallel then the resulting resistance is less than the value of the lowest resistance.

A similar state of affairs exists if two inductances are connected in parallel as the resulting inductance will be less than either of the two inductances.

Inductances are impedances, mainly reactive, and we can state the parallel resistances formula for impedances like this: $Z = (Z1 \times Z2) \div (Z1 + Z2)$.

We have stated above that one property of an inductance is to cause the current in an a.c. circuit to lag behind the voltage and it is proper to consider that anything that can cause the current to lag behind the voltage may be considered to have the property of an inductance even if physically it does not resemble an inductance in any manner.

We also know from a.c. theory that the effect of a capacitance in an a.c. circuit is the opposite of an inductance, that is, a capacitance causes the current to lead the voltage.

As mentioned earlier, a valve may be connected in such a manner that it appears to be a reactance and the circuit may be arranged so that this reactance can be either positive or negative.

Fig. 3 shows the circuit of a reactance valve modulator. This reactance valve modulator will appear as an inductive reactance.

Here briefly is the manner in which this occurs.

The resistance R is made very large in comparison to the capacitive reactance of condenser C and as a result of this, r.f. **current** from the oscillator tank circuit passing through R and C is essentially in phase with the **voltage** across the oscillator tank. This means that the current through condenser C is in phase with the voltage across the oscillator tank circuit.

Going back to a.c. theory, we remember that the **voltage** across condenser C will lag behind the **current** by 90° and it is **this voltage** which is applied to the grid of the valve. Now as the voltage on the valve grid varies so does the valve's **plate current** in phase with the grid voltage; i.e. whenever the grid voltage decreases so does the plate current and vice-versa.

It was stated above that the voltage across C is 90° out of phase with the current (lagging) and as the valve plate current is in phase with the grid voltage (across C), then the valve plate current lags behind the oscillator tank current by 90°, therefore the valve is, in effect, an inductance in parallel with the oscillator tank circuit.

The amount of plate current drawn by the reactance valve, and thus its effective inductance, depends on the grid bias of the valve. If the bias is changed by applying an audio frequency voltage to the grid of the valve, the plate current will vary in accordance with this voltage and so will the effective inductance of the valve. As this inductance is in parallel with the oscillator tank inductance, the frequency of the oscillator can be varied in amplitude in accordance with the amplitude of the audio frequency voltage and the rate at which the oscillator frequency is varied will be governed by the actual frequency of the a.f. voltage at the grid of the modulator valve.

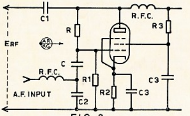

FIG. 3

REACTANCE VALVE MODULATOR

C and R, phase shift network; C1, d.c. blocking condenser; C2, C3, by-pass condensers; R1, grid leak; R2, cathode bias resistor; R3, screen dropping resistor; E, r.f. input voltage from oscillator "tank" circuit.

Thus an audio frequency has brought about frequency modulation of an oscillator valve by changing the inductance of the oscillator tank circuit.

If the condenser C and the resistance R in the reactance valve circuit are inter-changed and the reactance of C is made far greater than the resistance of R, then the r.f. **current** flowing through C and R will be 90° ahead of the r.f. **voltage** across the oscillator tank circuit and the reactance valve will appear as a capacitive reactance.

Therefore with an audio frequency voltage impressed on the grid of the reactance valve frequency modulation of the oscillator valve will be obtained by varying the capacitance of the oscillator tank circuit.

In practice the phase shifts may not be exactly 90° and in practical transmitters two reactance valves may be used in push-pull, also negative feedback may be employed.

The amount of frequency deviation that can be obtained is not very great so that it becomes necessary to use considerable frequency multiplication to get the necessary frequency deviation.

There is another way in which angle modulation differs from amplitude modulation. An amplitude modulated carrier frequency cannot be multiplied successfully because any multiplication also multiplies the sidebands and renders them unintelligible.

It is quite easy to amplitude modulate a carrier and beat or heterodyne it to another frequency because only the carrier frequency is changed. This is what happens in a superheterodyne receiver where an incoming amplitude modulated signal is heterodyned to an intermediate frequency for amplification. It does not matter if the a.m. signal is double sideband with carrier, d.s.b., s.s.b., or i.s.b.

However, an angle modulated carrier may be multiplied as well as heterodyned without difficulty.

Let us refer back to Fig. 2. The centre frequency is 100 MHz. and the deviation is ± 50 KHz. Suppose we have an oscillator on 4 MHz. and reactance valve modulates it to give a frequency deviation of ± 2 KHz. To put the carrier on 100 MHz. it will be necessary to multiply the 4 MHz. frequency twenty-five times and this will automatically increase the deviation frequency of ± 2 KHz. to ± 50 KHz. Actually a multiplication factor of twenty-five could be awkward to obtain but was chosen to make our figuring easy.

As mentioned previously, the development of solid-state devices has resulted in transmitters in which the full deviation can be obtained at the carrier frequency by direct modulation of the oscillator which is at the carrier frequency (d.c.f.m.), and as a result of this the reactance valve modulator is rapidly dropping out of favour.

One of the problems which occur when frequency modulation is derived by modulation of the oscillator is that the centre frequency of the oscillator may drift. (It is not usual to frequency modulate a quartz crystal oscillator although it can be done—if a crystal oscillator is to be used, it is more usual to employ phase modulation.)

There are several methods of keeping the oscillator on its centre frequency, despite modulation, and there are several variations of these methods. In one method a sample of r.f. from the oscillator is divided down to a lower frequency and compared to a quartz crystal oscillator. Stated simply, if the divided frequency and that of the crystal are the same, then there will not be any difference between them. However, if the modulated oscillator drifts then there will be a difference between the divided signal and the quartz crystal frequency. This difference can be extracted to determine if it is higher or lower than the crystal frequency, then amplified. It may then be fed to a two-phase electric motor which is geared to a small variable

(Continued on Page 10)

P.e.p., Average Power, and Related Matters*

JAMES N. THURSTON, W4PPB

When an Amateur picks up a catalogue and looks at the power ratings of transmitters or amplifiers, it is more than likely that he will be confused, dismayed or possibly convinced that manufacturers have double or triple standards when it comes to power ratings. It is my purpose to clear up some of this confusion by discussing what some of the power ratings actually mean.

The maximum input power that a transmitter can run is usually determined by the final amplifier stage. On one hand we have the problem of not exceeding the tube capabilities, especially with respect to dissipation. With the linear amplifiers that are used in s.s.b. service, the maximum input is also limited as to the amount of distortion in the form of flat-topping that can be tolerated.

As explained in the A.R.R.L. Handbook, p.e.p. is an abbreviation for peak envelope power. P.e.p. is the power resulting with key-down operating conditions, or conditions that occur on the highest audio peaks. Thus, a p.e.p. input of 100 watts means that the d.c. input power to the amplifier would be 100 watts if the maximum allowable steady signal were applied, if someone whistled the maximum allowable sine wave into the microphone, or if a two-tone input were applied so that the peaks would just reach 100 watts. In many linear amplifiers (except class A), the d.c. input power rises from a small value at zero signal input to a maximum with the drive signal applied. Also, if the amplifier is truly linear, the input signal and the output signal must be linearly related.

Perhaps some numerical examples will help to illustrate some common situations. For our first example let us suppose that we have an a.m. signal with a carrier rating of 100 watts. Assume that single-tone, sinusoidal modulation is applied so as to modulate the carrier 100%. Since the carrier amplitude doubles on modulation peaks with amplitude modulation, the input power on peaks will be four times the carrier value. Thus the amplifier must have a p.e.p. input rating of 400 watts. The average input power with 100% modulation will be 150 watts, since 50 watts will be supplied for the side frequencies. With a final amplifier stage that is 50% efficient, there will be 75 watts of power dissipated in the final amplifier tubes, for a steady 100% modulated input. Thus this final stage has the dual requirement of being able to handle a p.e.p. input of 400 watts without distortion and also of being capable of dissipating about 75 watts without overheating. Of course voice waveforms are not sine waves, and the average power figures given above are conservative as far as voice input is concerned.

As a second example, let's use the same amplifier rated at 400 watts p.e.p. and use it for s.s.b. operation. If a single-tone input is used, the peak power input of 400 watts which would result could not be permitted to continue for more than a very few seconds. The reason being that the input of 400 watts would mean that the tubes would be dissipating 200 watts, which is beyond the 75-watt dissipation rating previously assumed. Fortunately, however, the nature of the human voice with its pauses and variations in amplitude is such that the average power input is far less than the peak power input. An average power dissipation rating of 75 watts should normally be more than adequate for a 400-watt p.e.p. s.s.b. input. The ratio of p.e.p. ratings to average dissipation ratings is often six or eight to one, which explains why many s.s.b. transmitters must be tuned quickly, and why many are tuned up at a low level.

As a third example let us take a linear amplifier that is used for c.w. operation. In effect, it is either full on or full off, depending upon whether the key is up or down. Obviously the transmitter is heating up when the key is down, and is cooling off when the key is up. The duty cycle is a measure of the percentage **on** time, and is considerably less than 50% for average c.w. operation. Such factors as pauses, spaces between dots and dashes, and letters and words are of course taken into consideration. Usually a linear amplifier will run hotter with a given maximum input on c.w. than it does on s.s.b. because the usual duty cycle for c.w. is greater than it is for s.s.b. Because of this, many transmitters have c.w. ratings which are about 75% of their s.s.b. ratings.

As an example, the word "amateur" followed by a standard 7-unit space, has a duty cycle of slightly less than 50%. This is probably higher than that of an average text. A 40% duty cycle, with a maximum input of 400 watts, would mean an average power input of 160 watts, and a plate dissipation of 80 watts at the 50% efficiency level previously assumed. Under such conditions, the transmitter, if rated at 75 watts allowable dissipation, would overheat somewhat. The key-down input should therefore be reduced to 75/80 of 400 watts or 375 watts on c.w. as compared to 400 watts p.e.p. on s.s.b.

Much discussion over power measurement is heard on the air, and much of it is confusing. The term "d.c. input" is often used in connection with s.s.b. equipment. Without definition or qualification this term means little or nothing. When one talks into a microphone connected to a s.s.b. transmitter with a typical linear amplifier, the amplifier plate-current meter fluctuates from its resting value to peak values which are much higher. How high these peaks actually go depends on the voice waveform; what we read on the plate meter depends on the meter characteristics. It is often assumed that the highest meter reading is one half of the actual peak value, but this could be in error by a large factor. Actually an oscilloscope in the transmitter output circuit is the only accurate method of measuring peak power. A well set up two-tone measuring system as described in the A.R.R.L. Handbook is another method.

To summarise, both p.e.p. and average power values of input should be measured and understood in order to assure that the station transmitter is operating properly and within legal limits. Normally the s.s.b. peak power rating is the largest, with the c.w. rating close behind, and the a.m. carrier rating only about 25% of the s.s.b. p.e.p. rating.

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PRACTICAL V.H.F. AND U.H.F. COIL-WINDING DATA*

Complete Details on Inductors from 2 Nanohenries to 1 Microhenry

DONALD KOCHEN, K3SVC

This article contains computer generated data for building inductors from 2 to 1,000 nanohenries (1 nanohenry equals 0.001 μH.). Since no calculations are involved, it is a simple matter to scan the tables and select the inductor that best meets your particular requirements. The first part of the article describes single-layer solenoids from 10 to 1,000 nH.; the last part describes straight-wire inductors above a chassis that range from 2 to 100 nH.

V.H.F. INDUCTORS

Many v.h.f. experimenters have developed a sixth sense for winding r.f. coils—they've had to, since there does not seem to be any convenient coil winding data for this part of the spectrum. (The A.R.R.L. Lightning Calculator stops at 1 μH. and the Allied Coil Winding Calculator stops at 0.1 μH.)

The typical design procedure is to wrap some wire around a pencil (a coil form is also permitted) and trim the coil to resonance with the aid of a grid-dip meter and fixed capacitor. However, it takes a fair amount of experience to select the proper wire size and coil diameter that will give the desired inductance and still have reasonable Q and low capacitance.

Tables 1, 2, 3 and 4 describe coils of 1 to 10 turns wound with an inside diameter of ⅛" to ½".† Because of their size, these coils are especially attractive for use with solid-state receivers and transmitters.

DESIGN PHILOSOPHY

The goal is an inductor that has high Q, low capacitance and compact size. Low coil capacitance means the inductor will have a high self-resonant frequency, and therefore a more useful frequency range. This can be achieved by a single-layer solenoid with adequate turns spacing. A good rule of thumb is to have a space equal to the wire diameter between adjacent turns with coil length about 1.5 times the coil diameter. The result is a coil with low capacitance and reasonable Q. All coils computed in the tables have turns spacing equal to the diameter of the wire used; as a check, the overall length of the coil is also given.

Those coils whose length is 1 to 2 times diameter are shown in bold type since they are considered to be optimum. By scanning the tables you can see that any inductance can be obtained by an optimum coil.

All calculated inductances were rounded off to the nearest 10 nanohenries. This means that the error of values below 30 nH. will be ±5 nH. This seemed sufficient since adjacent objects will introduce errors into the free-space design anyway. Below 10 nH. it is usually easier to build straight-wire inductors.

USING THE TABLES

The tables are intended for air-core coils whose dimensions are indicated in Fig. 1. Each table describes coils wound with a different inside diameter. Wire size and number of turns are specified along the edge of the chart. The data within the table is inductance in nanohenries (on top) and coil length in inches (below). The use of the inductance tables is best illustrated by several practical examples.

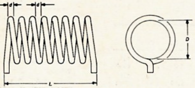

Fig. 1.—Air-wound coil showing construction dimensions.

Example 1:

What is the inductance of 5 turns of No. 18 wire, 0.25" diameter, wound with spacing equal to wire diameter?

From Table 2, opposite No. 18, and below 5 turns, you find this coil has 90 nH. inductance and is 0.44" long.

A coil of given inductance can be easily designed by scanning the optimum regions (bold-faced type) of each table. If the exact value is not found, the inductance may be mentally interpolated by changing the turns by a fraction or by compressing or expanding coil length.

Example 2:

A 50 nH. coil is required for a 20-w. transmitter. (Possibility is given first, then a comment.)

- 0.125" diam., 5 turns No. 24.
  Poor choice at this power level.
- 0.250" diam., 4 turns Nos. 12 or 14.
  Fair choice, only slightly out of optimum region.
- 0.250" diam., 3½ turns No. 16.
  Marginal at this power level.
- 0.250" diam., 3 turns No. 18.
  Marginal at this power level.
- 0.375" diam., 2.7‡ turns No. 10.
  Good choice.
- 0.375" diam., 2.7 turns No. 12.
  Good choice.
- 0.375" diam., 2.3 turns No. 14.
  Good choice.
- 0.500" diam., 2 turns No. 10.
  Good choice.
- 0.500" diam., 2 turns No. 12.
  Good choice.

Example 3:

Same 50 nH. coil as in Example 2, but this time it is required for a receiver.

- 0.125" diam., 5 turns No. 24.
  Good choice, compact size.
- 0.250" diam., 3.5 turns No. 16.
  Good choice.
- 0.250" diam., 3 turns No. 18.
  Good choice.
- 0.375" diam., 2.7 turns No. 10.
  Good choice, but large size may add too much capacitance to the circuit.

U.H.F. INDUCTORS

As you can see from Tables 1, 2, 3 and 4, it is impractical to wind coils less than 10 nH. For less than 10 nH. the inductance of a straight piece of wire is sufficient. Quarter-wavelength resonators are common in microwave work and may be considered as an inductance in parallel with distributed capacitance.

Full-sized quarter-wave resonators are useful above 1 or 2 GHz. because of their convenient size and high Q. But at 432 MHz. or even 1296, the designer may want a more compact resonator. This can be accomplished by shortening the length needed for quarter-wave resonance and making up for the decreased inductance by adding external capacitance.

Obviously this is a design trade-off resulting in a lower Q, since $Q = X_L/R$, and decreased inductance means lowered Q. However, you have gained more compact size: e.g., 432 MHz. tank circuits may be built 1 or 2 inches long as compared with a full quarter-wavelength of 7 inches. You have also avoided an impedance-matching problem since connecting circuitry will usually be capacitive anyway.

In a transistor tank circuit the collector capacitance, tuning capacitor and coil capacitance are combined. Output is taken by either capacitor-divider coupling, transformer coupling or tapping down on the coil. (Motorola has an excellent application note for r.f. transistor design.[2])

(Continued on Page 9)

* Reprinted from "Ham Radio," April 1971.

† The tables were computed from the formula

$$L = \frac{\left(\frac{ND}{2}\right)^2}{4.5D + 10l} \qquad (1)$$

where L is inductance, D is coil diameter and l is coil length. This formula approximates the low-frequency inductance of a coil in free space. However, after building a few coils and measuring their inductance with a Boonton 250A RX meter at 100 MHz. it appears that the error is only 10% for most coils.

‡ Instead of winding fractional turns, the coil may be wound with 3 turns and "stretched" to the desired inductance.

Wire Size	Number of Turns 1	2	3	4	5	6	7	8	9	10	
18	**5**	**10**	**20**	30	30	40	50	60	70	70	nH.
	0.12	**0.20**	**0.28**	0.36	0.44	0.52	0.60	0.69	0.77	0.85	Inch
20	5	**10**	**20**	30	40	50	50	60	70	80	nH.
	0.10	**0.16**	**0.22**	0.29	0.35	0.42	0.48	0.54	0.61	0.67	Inch
22	5	**10**	**20**	**30**	40	50	60	70	80	90	nH.
	0.08	**0.13**	**0.18**	**0.23**	0.28	0.33	0.38	0.43	0.48	0.53	Inch
24	5	10	**20**	**30**	**50**	**60**	70	80	100	110	nH.
	0.06	0.10	**0.14**	**0.18**	**0.22**	**0.26**	0.30	0.34	0.38	0.42	Inch

TABLE 1.—Coil data for 0.125 inch diameter air-wound coils.
(Bold-face values represent optimum designs)

Wire Size	Number of Turns 1	2	3	4	5	6	7	8	9	10	
12	**10**	**20**	**30**	50	70	80	100	120	130	150	nH.
	0.24	**0.40**	**0.57**	0.73	0.89	1.05	1.21	1.37	1.54	1.7	Inch
14	**10**	**20**	**40**	50	70	90	110	130	150	170	nH.
	0.19	**0.32**	**0.45**	0.58	0.71	0.83	0.96	1.09	1.22	1.35	Inch
16	10	**20**	**40**	**60**	**80**	100	120	140	170	190	nH.
	0.15	**0.25**	**0.36**	**0.46**	**0.56**	0.66	0.76	0.86	0.97	1.07	Inch
18	10	**30**	**50**	**70**	**90**	**120**	140	170	190	220	nH.
	0.12	**0.20**	**0.28**	**0.36**	**0.44**	**0.52**	0.60	0.69	0.77	0.85	Inch
20	10	30	**50**	**80**	**100**	**130**	**160**	**190**	220	250	nH.
	0.10	0.16	**0.22**	**0.29**	**0.35**	**0.42**	**0.48**	**0.54**	0.61	0.67	Inch
22	10	30	**60**	**90**	**120**	**150**	**180**	**220**	**250**	290	nH.
	0.08	0.13	**0.18**	**0.23**	**0.28**	**0.33**	**0.38**	**0.43**	**0.48**	0.53	Inch
24	10	30	**60**	**100**	130	**170**	**210**	**250**	**290**	**340**	nH.
	0.06	0.10	**0.14**	**0.18**	0.22	**0.26**	**0.30**	**0.34**	**0.38**	**0.42**	Inch

TABLE 2.—Coil data for 0.25 inch diameter air-wound coils.
(Bold-face values represent optimum designs)

Wire Size	Number of Turns 1	2	3	4	5	6	7	8	9	10	
10	**10**	**30**	**60**	80	110	130	160	190	210	240	nH.
	0.31	**0.51**	**0.71**	0.92	1.12	1.32	1.53	1.73	1.94	2.14	Inch
12	10	**30**	**60**	**90**	120	150	180	210	240	270	nH.
	0.24	**0.40**	**0.57**	**0.73**	0.89	1.05	1.21	1.37	1.54	1.70	Inch
14	10	**40**	**70**	**100**	**130**	170	200	240	280	310	nH.
	0.19	**0.32**	**0.45**	**0.58**	**0.71**	0.83	0.96	1.09	1.22	1.35	Inch
16	10	40	**70**	**110**	**150**	**190**	**230**	270	320	360	nH.
	0.15	0.25	**0.36**	**0.46**	**0.56**	**0.66**	**0.76**	0.86	0.97	1.07	Inch
18	10	40	80	**130**	**170**	**220**	**270**	**320**	**370**	420	nH.
	0.12	0.20	0.28	**0.36**	**0.44**	**0.52**	**0.60**	**0.69**	**0.77**	0.85	Inch
20	10	50	90	140	**190**	**250**	**310**	**360**	**420**	**480**	nH.
	0.10	0.16	0.22	0.29	**0.35**	**0.42**	**0.48**	**0.54**	**0.61**	**0.67**	Inch
22	20	50	100	160	220	**280**	**350**	**420**	**490**	**560**	nH.
	0.08	0.13	0.18	0.23	0.28	**0.33**	**0.38**	**0.43**	**0.48**	**0.53**	Inch
24	20	60	110	170	240	320	400	**480**	**560**	**650**	nH.
	0.06	0.10	0.14	0.18	0.22	0.26	0.30	**0.34**	**0.38**	**0.42**	Inch

TABLE 3.—Coil data for 0.375 inch diameter air-wound coils.
(Bold-face values represent optimum designs)

Wire Size	Number of Turns 1	2	3	4	5	6	7	8	9	10	
10	20	**50**	**80**	**120**	160	200	250	290	330	380	nH.
	0.31	**0.51**	**0.71**	**0.92**	1.12	1.32	1.53	1.73	1.93	2.14	Inch
12	20	50	**90**	**140**	**180**	**230**	280	330	380	430	nH.
	0.24	0.40	**0.57**	**0.73**	**0.89**	**1.05**	1.21	1.37	1.54	1.70	Inch
14	20	60	100	**150**	**210**	**260**	**320**	380	440	500	nH.
	0.19	0.32	0.45	**0.58**	**0.71**	**0.83**	**0.96**	1.09	1.22	1.35	Inch
16	20	60	110	170	**240**	**300**	**370**	**440**	**510**	580	nH.
	0.15	0.25	0.36	0.46	**0.56**	**0.66**	**0.76**	**0.86**	**0.97**	1.07	Inch
18	20	70	130	190	270	**340**	**420**	**500**	**590**	**670**	nH.
	0.12	0.20	0.28	0.36	0.44	**0.52**	**0.60**	**0.69**	**0.77**	**0.85**	Inch
20	20	70	140	210	300	390	**480**	**580**	**680**	**780**	nH.
	0.10	0.16	0.22	0.29	0.35	0.42	**0.48**	**0.54**	**0.61**	**0.67**	Inch
22	20	80	150	240	340	440	550	660	**780**	**900**	nH.
	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.43	**0.48**	**0.53**	Inch
24	20	80	160	260	370	490	620	750	890	1030	nH.
	0.06	0.10	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.42	Inch

TABLE 4.—Coil data for 0.5 inch diameter air-wound coils.
(Bold-face values represent optimum designs)

Wire Size	Length (Inches) 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
	2	5	9	12	15	19	22	26	29	33	nH.
2	0.4	0.7	1.1	1.5	1.8	2.2	2.5	2.9	3.3	3.6	pF.
	5.3	2.4	1.5	1.1	0.9	0.7	0.6	0.5	0.5	0.4	GHz.
	3	6	10	14	18	22	26	30	34	38	nH.
4	0.3	0.6	0.8	1.1	1.4	1.7	2.0	2.3	2.5	2.8	pF.
	5.4	2.4	1.6	1.2	0.9	0.8	0.6	0.6	0.5	0.4	GHz.
	3	7	12	17	21	26	30	35	40	44	nH.
6	0.2	0.5	0.7	0.9	1.2	1.4	1.6	1.9	2.1	2.3	pF.
	5.5	2.5	1.6	1.2	0.9	0.8	0.7	0.6	0.5	0.5	GHz.
	4	9	14	19	24	29	34	40	45	50	nH.
8	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	pF.
	5.5	2.5	1.6	1.2	0.9	0.8	0.7	0.6	0.5	0.5	GHz.
	4	10	15	21	27	33	38	44	50	56	nH.
10	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	1.6	1.8	pF.
	5.4	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	5	11	17	23	30	36	42	49	55	62	nH.
12	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.6	pF.
	5.4	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	5	12	19	26	33	40	47	54	61	67	nH.
14	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.1	1.3	1.4	pF.
	5.4	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	6	13	21	28	36	43	51	58	66	73	nH.
16	0.1	0.3	0.4	0.5	0.7	0.8	0.9	1.0	1.2	1.3	pF.
	5.3	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	6	14	22	30	38	47	55	63	71	79	nH.
18	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	pF.
	5.3	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	7	15	24	33	41	50	59	68	76	85	nH.
20	0.1	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.1	pF.
	5.3	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	7	17	26	35	44	54	63	72	82	91	nH.
22	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.1	pF.
	5.2	2.5	1.6	1.2	1.0	0.8	0.7	0.5	0.5	0.5	GHz.
	8	18	27	37	47	57	67	77	87	97	nH
24	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	pF.
	5.2	2.5	1.6	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.

TABLE 5.—Inductance of wire 0.25 inch above a ground plane.
(Upper value is inductance in nH., middle value is capacitance in pF., lower value is self-resonant frequency in GHz.)

Wire Size	Length (Inches) 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
	3	7	12	17	22	27	32	38	43	48	nH.
2	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	pF.
	6.3	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	3	8	14	19	25	31	36	42	48	54	nH.
4	0.2	0.4	0.5	0.7	0.9	1.1	1.2	1.4	1.6	1.8	pF.
	6.2	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	4	9	15	21	28	34	40	47	53	59	nH.
6	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.6	pF.
	6.1	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	4	10	17	24	31	37	44	51	58	65	nH.
8	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.1	1.3	1.4	pF.
	6.0	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	5	11	19	26	33	41	48	56	64	71	nH.
10	0.1	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2	1.3	pF.
	5.9	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	5	13	20	28	36	44	53	61	69	77	nH.
12	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	pF.
	5.8	2.7	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	6	14	22	31	39	48	57	65	74	83	nH.
14	0.1	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.1	pF.
	5.8	2.6	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	6	15	24	33	42	51	61	70	79	89	nH.
16	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.1	pF.
	5.7	2.6	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	7	16	26	35	45	55	65	75	85	94	nH.
18	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	pF.
	5.6	2.6	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	7	17	27	38	48	58	69	79	90	100	nH.
20	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.9	pF.
	5.6	2.6	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	8	18	29	40	51	62	73	84	95	106	nH.
22	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9	pF.
	5.5	2.6	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	9	19	31	42	54	65	77	89	100	112	nH.
24	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.8	pF.
	5.5	2.6	1.7	1.2	1.0	0.8	0.7	0.6	0.5	0.5	GHz.

TABLE 6.—Inductance of wire 0.5 inch above a ground plane.
(Upper value is inductance in nH., middle value is capacitance in pF., lower value is self-resonant frequency in GHz.)

Tables 5, 6 and 7 contain computed data describing a wire of diameter D and length L, spaced height H above a ground plane as shown in Fig. 2.§ Wire size, height above ground and length in inches are specified along the edge of the inductance tables. The data within the table is inductance (nH.) on top, capacitance (pF.) in the middle, self-resonance (GHz.) on the bottom. As before, the use of these tables is best illustrated by several typical examples.

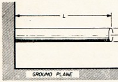

Fig. 2.—Length of wire above a ground plane exhibits both inductance and capacitance. Dimensions are used to calculate values.

§ The inductance values shown in Tables 5, 6 and 7 were calculated from the formula

$$L = .0116967\left(\log 4H/D + \log \frac{A}{B}\right) + .00508\left(B - A + \mu 1\delta - 2H + \frac{D}{2}\right)$$

$$\text{where } A = 1 + \sqrt{1^2 + \frac{D^2}{4}}$$

$$B = 1 + \sqrt{1^2 + 4H^2}$$

$$\mu \text{ (permeability)} = 1$$

Skin effect, because of its very small value, was neglected. The capacitance of the straight wire above a ground plane was calculated from

$$C = \frac{\pi \epsilon l}{\ln \frac{(4H-1)}{D}}$$

where ϵ is permitivity. As a check, capacitance measurements were made on a Boonton 250A RX meter operating at 1 GHz. Readings were within 0.4 pF. of the calculated values. Next, the circuit of Fig. 2 was duplicated, and a signal generator and r.f. detector were loosely coupled to the resonator. For each case measured the self-resonant frequency was within 20% of that calculated from the computed inductance and capacitance. It is also gratifying that there is some correlation between the computed LC resonant frequency and resonance of quarter-wave transmission lines.

Example 4:

What are the characteristics of a 2" length of No. 10 wire, spaced 0.25" above a ground plane?

From Table 5, a 2" length of No. 10 wire has 21 nH. inductance in parallel with 0.7 pF. Self-resonant frequency 1.2 GHz. (1200 MHz.)

DESIGN PHILOSOPHY

A quick scan of Tables 5, 6 and 7 reveals some interesting phenomena that should be kept in mind when laying out circuits. For example, moving the inductor closer to a ground plane increases its capacitance. Not so obvious is the fact that this also decreases inductance. The inductor and the ground plane may be considered

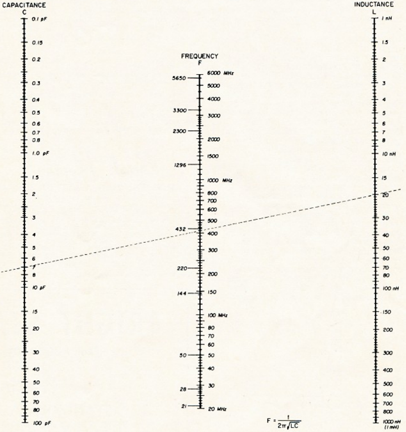

Fig. 4.—Resonant-frequency nomograph may be used to determine capacitor and inductor values over range from 20 to 6,000 MHz. The example indicates that 20 nH. will resonate at 425 MHz. with a 7 pF. capacitor.

Wire Size	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
	3	8	14	21	27	34	41	47	54	61	nH.
2	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.1	1.3	1.4	pF.
	7.1	3.0	1.9	1.3	1.0	0.9	0.7	0.6	0.6	0.5	GHz.
	3	9	16	23	30	37	45	52	59	67	nH.
4	0.1	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2	1.3	pF.
	6.9	3.0	1.8	1.3	1.0	0.9	0.7	0.6	0.6	0.5	GHz.
	4	10	18	25	33	41	49	57	65	73	nH.
6	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	pF.
	6.7	2.9	1.8	1.3	1.0	0.8	0.7	0.6	0.6	0.5	GHz.
	4	11	19	27	36	44	53	61	70	78	nH.
8	0.1	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.1	pF.
	6.5	2.9	1.8	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	5	13	21	30	39	48	57	66	75	84	nH.
10	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.1	pF.
	6.4	2.8	1.8	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	5	14	23	32	41	51	61	71	80	90	nH.
12	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	pF.
	6.3	2.8	1.8	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.

Wire Size	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
	6	15	24	34	44	55	65	75	86	96	nH.
14	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.9	pF.
	6.2	2.8	1.8	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	7	16	26	37	47	58	69	80	91	102	nH.
16	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9	pF.
	6.1	2.8	1.8	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	7	17	28	39	50	62	73	35	96	108	nH.
18	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.8	pF.
	6.0	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	8	18	30	41	53	65	77	89	101	114	nH.
20	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	pF.
	5.9	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	8	19	31	44	56	69	81	94	107	119	nH.
22	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.8	pF.
	5.8	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.
	9	21	33	46	59	72	85	99	112	125	nH.
24	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.7	pF.
	5.8	2.7	1.7	1.3	1.0	0.8	0.7	0.6	0.5	0.5	GHz.

TABLE 7.—Inductance of wire 1.0 inch above a ground plane.
(Upper value is inductance in nH., middle value is capacitance in pF., lower value is self-resonant frequency in GHz.)

to be a transformer with a shorted secondary. Hence, increased coupling results in less inductance. It turns out that the capacitance changes more than inductance, and the net result is a lower resonant frequency.

Moving the inductor away from the chassis will raise the Q. Beyond a height of one inch, however, the computed L and C rapidly approaches the free-space inductance as a limit, and the law of diminishing returns applies.

Considering the resonator as a transmission line, its characteristic impedance is $Z_o = \sqrt{L/C}$. Thus, moving the quarter-wave resonator too far from the chassis will raise its impedance to match the approximately 377-ohm radiation resistance of space. Then the resonator will then behave more like an antenna than a resonator.

Adding additional ground planes at right angles to form a co-axial cavity around the wire lowers the resonant frequency by about 10%. This implies that L and C have changed by more than that amount since they move in opposite directions. An estimate of the inductance and capacitance of a co-axial shielded wire can be made by considering it simply as a wire that is closer to a single ground plane.

U.h.f. resonators are usually made from the larger diameter wires, but data for wires smaller than No. 18 is included mainly for estimating component-lead inductance. The resonant frequency given in the table sets the upper limit at which the inductor may be used; above resonance it acts like a capacitor. The inductor should be chosen so that with the added external circuit capacitance the LC combination will resonate at the desired frequency.

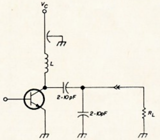

Fig. 3.—Typical 425 MHz. tank circuit. Effective circuit capacitance of 7.4 pF. will resonate with 19 nM. at 424 MHz.

Example 5:

It is desired to design a transistor tank circuit for 430 MHz. as shown in Fig. 3. The transistor has an output capacitance of 3 pF., and the two impedance-matching variable capacitors are assumed to present an average capacitance of 4 pF. at the collector. Thus, total capacitance will be 7 pF. plus inductor capacitance. An LC nomograph (Fig. 4) indicates that 20 nH. will resonate with 7 pF. at 425 MHz.

The data for No. 14 wire spaced 0.25" above a ground plane (Table 5) shows that a 1½" length has 17 nH. inductance and 10.5 pF. capacitance. Therefore, the tank circuit consists of 19 nH. in parallel with 17.4 pF. and has a mid-range resonance of 424 MHz.

SUMMARY

It is one thing to design on paper but u.h.f. and microwave work always require a certain amount of "cut and try". The approximations made and factors ignored in this article would probably send chills up the spine of a physicist. However, physicists don't have to design equipment and make things work.

Each piece of equipment is a unique problem. Armed with basic data and some mental fudge factors, the designer can obtain a quick solution of reasonable accuracy. Compared to that, an exact calculation is usually impractical.

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1. "Reference Data for Radio Engineers," fifth edition, I.T.T.
2. Frank Davis, "Matching Network Designs with Computer Solutions," Motorola Application Note AN-267, Motorola Semiconductor Products, Inc., Box 995, Phoenix, Arizona, 85001.
3. Keith Henney, Radio Engineering Handbook, McGraw-Hill, New York.
4. John Ryder, "Network Lines and Fields," 2nd edition, 1949, Prentice-Hall, New York.

Book Review

UNDERSTANDING AMATEUR RADIO

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Amateur Radio has something to interest all types of people. Amateur Radio also provides a training ground whereon newcomers can learn Electronics and Communications principles and practice. "Understanding Amateur Radio" takes the newcomer through from first principles to a complete and quite elaborate station in a clear and concise manner. See the Secretary of your Division for this and many other interesting titles, or write to Federal Executive.—VK3ASC.

ANGLE MODULATION

(Continued from Page 5)

condenser, connected across the oscillator tuned circuit and this brings the oscillator back on its centre frequency if it drifts.

In another method the two-phase motor is replaced with an automatic frequency control (a.f.c.) which produces a voltage whose polarity depends on the direction of the oscillator drift and the amplitude is governed by the amount of drift. This voltage is applied as bias to the grid of the reactance valve modulator or to the varactors if they are being used to derive the frequency modulation.

As has been stated, it is difficult to frequency modulate a quartz crystal, but the Marconi Co. developed a method using a quarter wave transmission line between a reactance valve modulator and a quartz crystal. The crystal oscillates at 1/24th of the carrier frequency and the reactance valve modulator is capable of swinging the crystal frequency ±3.125 KHz. When the crystal frequency is multiplied twenty-four times to obtain the carrier frequency the deviation is ±75 KHz. There is f.m. sound broadcasting in Britain and ±75 KHz. is the maximum deviation permitted.

(to be continued)

ERRATUM

Re article "Angle Modulation," Lecture No. 14A, in July 1971 "A.R.," page 9, column 1, second complete paragraph: The cut-off frequency should read 7½ KHz., not 1½ KHz.

V.H.F. METEOR SCATTER PROPAGATION

Hints on using Meteor Trail Ionisation for Six Metre DX

WALLY WATKINS, VK5ZWW (ZL2TCW)*

In most textbooks towards the end of the chapter dealing with v.h.f. propagation, reference is made to the esoteric forms of communication. However one look at the table, which shows antenna power and receiver capabilities necessary for these forms, usually puts paid to any idea of using them.

Meteor scatter is no mode for the casual operator. However, it is within the grasp of all v.h.f. operators in Australia who have reasonable gear, ample patience and operating skill at both ends of the path.

Since August 1970 experiments and tests have been carried out to determine power levels and antennae required for meteor scatter in Australia. The path Tennant Creek, N.H., and Adelaide, S.A., was used for primary evaluation, the distance being 1,100 miles. Antennae and receiving set-up was similar at each end of the path but transmitter power was different.

As is generally known, the meteor signal is reflected, not from the particle itself, usually the size of a grain of sand, but from the stream of ionisation left by the meteor as it is heated and vaporised by friction with the atmosphere.[1] This takes place in the E layer, about 100 km. above the earth, so that distances worked closely correspond with those of Es propagation.

It must be pointed out at this stage that there are two sets of conditions existing for meteor scatter propagation. Firstly random meteors exist throughout the twenty-four hours peaking to a maximum at 0600 local sun time and dropping to a minimum at 1800 hours. The second is when the earth passes through a belt of space debri, which is predictable from year to year, and is known as a meteor shower. For those who wish to delve more deeply into the mechanics of meteor scatter, the classic article by Walt W4LTU in "QST" of April 1957 is recommended.

It has been found that the minimum transmit requirements are well within the scope of the average Amateur. A 6 element beam is quite satisfactory provided it is up high enough to clear surrounding objects. The transmitter should run a 6/40 in the final with either 600 or 1,000 volts on the anodes. It is assumed that one is running s.s.b. and the 6/40 is operating in AB1.

At this location the FT-DX-100 runs into a homebrew transverter using an E80CF oscillator-buffer at 24 MHz., a 6939 mixer-driver and a 6/40 with 1,000 volts on the anodes. The converter is a VK3 FET with oscillator injection from the E80CF. The antenna is a 9 element yagi on a 30-foot boom.

Because it is possible to talk faster than the average Amateur can copy c.w., s.s.b. is superior for this type of propagation. A voice average is about 80 w.p.m. and even though only bits of words are heard at a time, the whole text can be more easily pieced together. It is not intended to denigrate c.w., for c.w. has been found to be a convenient way of station identification, especially with solid state programmed keyers. However s.s.b. is usually used for the actual exchange of reports.

* 244 Shepherds Hill Rd., Bellevue Heights, S.A., 5050.

WHAT IS NEEDED?

What is now needed to make an actual contact via meteor scatter? First you must arrange for someone to be on frequency at the appropriate time. Thereafter patience is needed. It is here that the phrase "esoteric communication" takes on real meaning. If one participant has had previous experience and has passed on this experience to the other, then everything will fall readily into place.

For random meteors a five-minute calling period is used with each station taking alternate turns to call and listen. The identification, call signs and/or reports are repeated for the five-minute period. I have found that pre-recorded endless tapes are ideal for this purpose. During the peak of a known shower, the technique changes. The five-minute calling periods are retained, however station identification is given followed by a key-up period of three seconds. This allows for a form of break-in operation and enables the other station to attempt a reply on the same meteor trail. The second method can be used during random meteor attempts but it is not recommended until some experience is obtained using the first method.

Frequency readout should be capable of an accuracy of ± 500 Hz. and timing of segments can be synchronised with VNG or WWV. Over most paths enough is received during the first five-minute segment to v.f.o. onto the frequency and this is desirable even though it may be slightly off the nominal frequency.

What frequency should be used? This is a matter of personal choice and would be one subject brought up when arranging skeds. Two stations at one end of the path would be advised not to transmit during the same five-minute segment as this would preclude break-in operation. It is also recommended that stations calling with an easterly component in their antenna heading should call during the odd five-minute segments of the hour and those with a westerly component listen during the odd five-minute segments. During the even segments the roles are reversed.

Identification in the form "This is VK5AA" is acceptable, but phonetics **must not be used**. Identification is kept up until something definite is heard, then a special reporting system is used or if a contest is on the usual cypher is given.

REPORTING

Report coding for s.s.b. is as follows (c.w. coding would consist of only the initial letter or letters):

Tango (T)	=	Bits—not enough to identify.
Mexico (M)	=	Words which can be pieced together to make out call signs and/or report.
Oscar (O)	=	Both call signs and/or report copied in a single burst.
Roger (R)	=	Report received.

Combinations of M-R and O-R should be self explanatory and are frequently used. For "break-in" type of operation, providing it has been arranged in advance, there is no need to include the word "break" in the identification as this would be a waste of valuable time. Once contact has been established much time can be saved if extraneous matter in the way of call signs is kept to a minimum. The report or cypher is the important matter to get across and must, of course, be repeated more frequently.

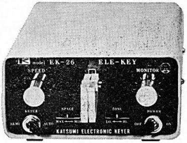
If you are interested in trying this form of propagation you will find it is now up to you to take that first step and arrange that first sked—you will be surprised by how much you hear.

Meteor scatter should lead to some good "Ross Hull" scores this year, especially during the "Geminids" shower in December. On 13th and 14th December, 1970, VK8AU and VK5ZWW swapped two cyphers via M/S using break-in operation, so it can be done.

Thank you to those who have kept skeds with me (between 0500 and 2400), namely VK8AU, VK8KK, VK4RO, VK-2ZQJ, VK2ZNS, VK2ZRH, VK1VP, VK3ASV, VK3ZQC, VK5ZDX, VK5QZ and VK5ZDY,[2] and to those 6 metre operators in Adelaide who have put up with endless hours of endless tape giving my identification.

REFERENCES

1. "QST," April 1957, p. 20.
2. Up to 30th June, 1971.



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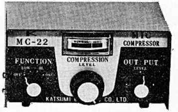

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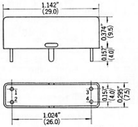

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HOME STATION ANTENNA FOR 160 METRES

Part Four—Practical Application

J. A. ADCOCK, M.I.E. (Aust.) VK3ACA*

VERTICAL vs. HORIZONTAL FOR TRANSMITTING

As can be seen from Fig. 1, the majority of signal from a vertical is along the ground and zero in the vertical direction, whereas with a horizontal the signal is zero along the ground and maximum vertically. Since surface wave propagation is by the vertically polarised mode only, only the vertical component is useful in surface wave propagation. During the day this mode of propagation may be useful over a distance of 100 miles over flat country—example, Melbourne to Colac; propagation is poor over mountainous country being not much use more than 10 miles. At night propagation via the ionosphere is possible.

With the vertical antenna signals returned via the ionosphere will be weak close to the transmitter and strong some distance away. This gives rise to a dead zone between the limits of the ground wave and the sky wave. If the lobe signal strength from a horizontal and a vertical were equal, the strength of the rays at 45° to the ground would be equal, this corresponds to a distance of approximately 350 miles. In fact if the vertical and horizontal were of equal efficiency, the peak lobe signal strength at right angles to the wire is greater for the horizontal than the vertical.

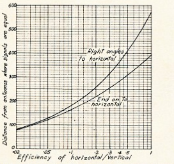


Fig. 16.—The distance in miles, from the antenna up to which the horizontal is advantageous, is plotted against comparative efficiency. The curves are for signals reflected from an ionosphere 180 miles high by a single hop. The earth is assumed to be flat and the effect is illustrated in Fig. 17.

Antennas of equal efficiency would produce signals of equal signal strength at distances of up to 600 miles broadside to the horizontal or 400 miles end on. Inside these distances from the transmitter the signal from the horizontal would be stronger. Outside these distances the signal from the vertical would usually be stronger. This effect is illustrated in Fig. 17. (These figures are based on the assumption that the signals are mainly reflected by the F layer at night. This is true at least at high angle radiation. The matter is more complicated when considering lower layer reflection.)

Where the horizontal antenna is less efficient (this includes most practical cases for short antennas close to the ground) the area in which the horizontal is advantageous becomes less. A horizontal with an efficiency of only half that of the vertical will still give an advantage over a distance from 300 to 400 miles. The use of a horizontal of very poor efficiency can provide a useful signal in the dead zone (between 20 and 100 miles at night).

The distance over which the horizontal should be preferable to the vertical is shown in the graph Fig. 16. The graph is based on the assumption of an ionosphere height of 180 miles and a flat earth. (Efficiency referred to is power efficiency as calculated by the methods given in other sections.) These assumptions are reasonable for late at night and over the distances considered. If it is desired to apply the graphs to other ionospheric heights the distances can be worked out by simple proportion.

VERTICAL vs. HORIZONTAL FOR RECEIVING

For receiving surface waves the same applies to receiving as transmitting—the receiving antenna must be largely vertical for best results. For receiving signals via the ionosphere, the situation is quite different. Since a signal loses polarisation via the ionosphere it does not follow that the transmitting and receiving antennas must be of the same polarisation. The receiving patterns for the two antennas will be the same as their transmitting patterns.

Since the main concern of a receiver is signal to noise ratio, relative efficiencies of receiving antennas are of no significance (it being assumed that the antenna noise is well above the threshold noise of the receiver). The main consideration is the angle from which the noise is coming. The majority of local noises are vertically polarised. The majority of distant static is received at a low angle and therefore received best on a vertical antenna. Local storms and storms within a radius of 500 miles will probably produce a stronger noise on a horizontal antenna.

Because most noise is received best on a vertical antenna, very considerable advantages can accrue from using a horizontal receiving antenna. Another advantage of a well balanced horizontal is that it gives good rejection against strong local signals. The best mode of the receiving antenna under different noise conditions for different propagation distances are shown in Table 1.

It can often happen that an interstate or country signal can be almost inaudible on a vertical antenna and 5 and 9 on a horizontal.

To take full advantage of horizontal reception it is desirable that the antenna should have practically no vertical component. This is difficult to achieve because of the tendency of the vertical component to dominate. For best results the virtual ground should be parallel with the antenna. The antenna, feeders and tuning unit should be balanced and as symmetrical as possible. The position is complicated by surrounding buildings. Objects like drain pipes and iron roofs may be sufficiently coupled to the antenna to produce a considerable vertical component and thus destroy some of the properties of the horizontal.

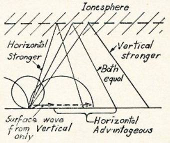


Fig. 17.—Illustrating how a horizontal with an efficiency less than that of a vertical can produce a stronger signal in a limited area.

CALCULATIONS AND DISCUSSION

The purpose of this discussion is to examine results obtained in practice and to endeavour to make some useful conclusions. Most of the practical results agree with those obtained by calculations. Some of the conclusions drawn are largely supposition, but should be useful to any person who is experimentally inclined and would like to try them in practice.

The antenna used by the author is a horizontal centre fed length of wire 84 feet long and 30 high. The feeders

	Low Noise Conditions	High Noise Conditions
1. Surface Wave	Vertical	Vertical
2. Intermediate distances up to 800 miles	Horizontal or sometimes Vertical	Horizontal
3. Long distances	Vertical	Either, depending on results

Table 1.

* P.O. Box 106, Preston, Vic., 3072.

are sloping but these have been considered vertical. The feeders can be fed either in parallel against ground or as a doublet. The normal earth consists of a water pipe driven into the ground close to the transmitter plus four radials at right angles averaging 20 feet long and connected at the ends to various objects such as water pipes. A counterpoise is available for erection when required. The counterpoise is parasitically tuned against ground as in Fig. 12 (b). The power input to the class C final of the transmitter is 50 watts and allowing for 70% efficiency, is approximately 35 watts input to the antenna.

The values of resistance in each case were initially determined by $W \div I^2$, as described in Part Two. Later, measurements of both resistance and reactance were made using a Wayne Kerr type B201 bridge. An attempt was also made to make measurements on a Q meter but it was found that there was too much interference from the antenna. In general, the R values were higher than those measured by the bridge, suggesting that the estimation of power input may have been too high.

The value of resistance was found to be difficult to measure in the case of the balanced horizontal. This was because the resistance is the minor component and is more difficult to measure, and also the bridge was not balanced to ground. The values shown here were measured on the bridge except the resistance of the doublet which was calculated from $W \div I^2$. If the bridge was correct, it would make the value of R about 10 ohms.

The following were the values determined for the purpose of calculation.

The antenna with feeders in parallel:
$R = 23$ ohms.
$X = 135$ ohms (650 pF.).

As above, but with a counterpoise:
$R = 7.7$ ohms.
$X = 173.5$ ohms (501 pF.).

Fed as a doublet:
$R = 6.2$ ohms.
$X = 658$ ohms (132 pF.).

Calculations for the Vertical Antenna

Series-Parallel Conversion.—In earlier sections, series-parallel conversion was referred to. It is interesting to consider this conversion although details here are not given and only the first case is considered.

Series resistance = 23 ohms
Series reactance = 135 ohms.

These values would be represented by the equivalent series circuit of the load Fig. 3c.

By applying the standard formula (Ref. 5):

Parallel resistance = 814 ohms
Parallel reactance = 139 ohms.

These values would be represented by the equivalent parallel circuit Fig. 3c.

This means that if the antenna was tuned by a series reactance Fig. 11a, the load presented to the line would be 23 ohms. If a parallel tuned circuit was used, such as Fig. 11d or e, the resistance of the load in parallel with the coil would be 814 ohms. To match a 50-ohm line, the turns tapping would be in the ratio $\sqrt[3]{814 \div 50} = 4$ to 1.

Efficiency Case 1.—The antenna with feeders in parallel:

Electrical length of half top ($\lambda/4 = 1$) = 0.312.

Equivalent electrical length of top (Fig. 10) = 0.52.

Electrical length of vertical section = 0.222.

Form factor (from Fig. 7) = 0.91.

From equation (6):
$R_R = 98.75\ (0.91 \times 0.222)^2 = 4.03$ ohms.

Electrical distance of feed point from the end of the antenna:
$0.52 + 0.22 = 0.74$.

The accuracy of the efficiency calculations and the application of the graphs depends largely on whether this point, 0.74, is correct. As pointed out earlier, it can be checked from the known reactance at the point being considered.

From Fig. 9 at 0.74, X = 250. This is not a good agreement but when calculated for a point where X = 135, R_R would be 4.2 ohms. Not a large difference in this case.

From equation (8):
Efficiency = $4.03 \div 23 = 0.175$ (17.5%).
Loss resistance = $23 - 4.03 = 19$ ohms.

Case 2.—In the case of the antenna with the counterpoise connected, R_R and X should still be the same but since the counterpoise is above the ground the length of the radiating section was 3 ft. shorter vertically.

Equation (6): $R_R = 3.28$ ohms.

Efficiency, equation (8) = 0.43 (43%).

If this result is correct it would suggest a 4 dB. improvement when using the counterpoise. From on-air checks, estimates of improvement vary from very little to 2 S points. Although these readings are not conclusive, the results indicate a worthwhile improvement.

The Effect of the Horizontal Section.—Many find it difficult to believe that the horizontal section of the antenna adds nothing to the radiation even when the top is larger than the vertical section. Some mistakenly refer to a "T" or an "inverted L" as a horizontal and think that the direction of the antenna will affect the radiation pattern. Although the top of the antenna produces no useful radiation it does greatly increase the efficiency. The loss resistance for the original "T" antenna was calculated to be 19 ohms. If the top was removed the loss resistance would be at least as high.

Radiation resistance with the top = 4.03 ohms.

Radiation resistance without the top:
F for a 0.222 vertical (Fig. 7) = 0.505.

From equation (6):
$R_R = 98.75\ (0.222 \times 0.505)^2 = 1.24$ ohms.

Efficiency = $1.24 \div (1.24 + 19) = 0.061$.

Compare this with the "T" antenna with an efficiency of 0.208, the improvement with the top section added would be 3.3 times (i.e. 3.3 times the radiated power).

Calculations for the Horizontal Antenna

The length of one leg of the top = 42 ft.

Electrical length of top ($\lambda/4 = 1$) = 0.312

Form factor (Fig. 7) = 0.51

From equation (11):
$R_R = 197.5\ (0.312 \times 0.51)^2 = 5.0$ ohms

Electrical length of feeder = 0.222

Electrical distance from end of antenna to tuner = $0.222 + 0.312 = 0.534$.

Refer to the graph of Fig. 14, the radiation resistance calculated above can also be obtained from the dotted curve (point 1). The resistance at the end of the line can be found by continuing along the graph to electrical distance 0.534. The resistance at this point would be 1.9 ohms—point 2 on Fig. 14. From measurement, the resistance was actually 6.2 ohms. If we take 6.2 ohms at point 0.534 (point 3), this corresponds to a resistance at the centre of 16 ohms (point 4) and an s.w.r. of 180. If the ground were perfectly conducting the resistance should be (from Fig. 15):
$5.0 \times 0.093 = 0.465$.

To sum up the following emerges:

Radiation resistance above perfect ground = 0.465 ohm.

Radiation resistance in space = 5.0 ohms.

Actual resistance = 16 ohms.

The actual effect of a poorly conducting ground is impossible to determine. Is it possible to apply the same method for determining efficiency as for a vertical antenna? That is: efficiency = theoretical radiation resistance ÷ actual resistance.

In the case being considered,
Efficiency = $0.465 \div 16 = 0.029$ (2.9%).

As with the vertical antenna a check was made to see if the measuring point was as calculated. To check this, the reactance can be obtained from Fig. 9 at point 0.534 as 530 ohms, which compares with 658 ohms (measured) which corresponds with 0.47 from the end. This represents an error which, if correct, would make little difference to the feed point resistance calculations. It probably indicates that the antenna proper had a characteristic impedance greater than 600 ohms.

Comparing the efficiency of the horizontal with that of the vertical, the result is:
$0.029 \div 0.175 = 0.165$.

Some results obtained from reports when comparing the horizontal with the vertical for transmitting were as follows:

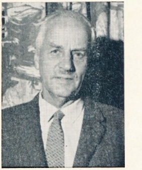
(Continued on Page 15)

OBITUARY

AIR COMMODORE ALFRED GEORGE PITHER, C.B.E., VK3VX

It is with the very deepest regret that Federal Council and Executive records the passing away suddenly of Air Commodore Alfred George Pither, C.B.E., VK3VX, on Friday, 2nd July.

After his retirement a few years ago from the active list of the R.A.A.F., he decided to take up Amateur Radio and was helped by his great friend, Dr. Alan Butement, VK3AD, towards obtaining the licence. George started off with a Swan 350 and had been on the air regularly since then, with fresh fields on 2 metres to explore on his return from Japan a few months ago.



George came on to Federal Executive early in 1967, firstly on Intruder Watch activities and later with the I.T.U. portfolio. An early article on this subject by him appeared in "A.R." of July 1967. Since that date he had been keen and active in Federal affairs and it is a tribute to his great personality that all the members of Federal Executive attended the funeral and wreaths were sent from afar.

Born in Victoria, George was 62 years of age, having devoted his life to the R.A.A.F. which he joined on passing out from Duntroon. From the beginning of the war he was concerned with radar and was the prime mover in setting this up in Australia and in Darwin and the North in particular during hostilities. After the war years had passed into memory he became Superintendent of the Woomera rocket range and held this post for several years. It was under him that so many social and general activities blossomed in that place. He himself even took to painting with water colours a la Churchill.

A grand personality. He will be sadly missed by all who knew him.

CHARLES FRYAR, VK2NP

It is with deep regret we report the passing on of this true Amateur on Friday, 2nd July, 1971. He was an excellent operator on both phone and c.w. At one time he won the W. T. Crawford Trophy as a Morse operator.

He was well known and respected on and off the air. He was well known on 2 metres and it was a joy and enlightenment to QSO him on this band.

He was one of the greatest givers of all times, both with his knowledge and bits and pieces, and was very interested in field operations as some of his friends can tell.

Charlie was a licensed Amateur since 1930 and was very active until a couple of years ago when he became too ill to use his gear. He was the instigator of the Gladesville and District Radio Club, started in 1937.

INTRUDERS

No complaints ∴ no interference so they stay put!

ANTENNA FOR 160 METRES

(Continued from Page 14)

Distance 30 miles (no surface wave path): horizontal 2 S points better than vertical.

Distance 100 to 150 miles: on some occasions equal, better or worse.

Distance 500 miles: horizontal between 1 and 3 S points down on vertical.

It would appear that the distance where signals were equal from the two antennas is between 100 and 150 miles. From Fig. 16 the distance should be between 200 and 230 miles. This may indicate that the horizontal was even less efficient than calculated! The actual results were rather variable, suggesting considerable differences in conditions, but the final results would appear to confirm the calculations so far.

Fantasy

The rather rash assumption that efficiency for a low short horizontal can be worked out by such a simplified formula would appear to work out in this case. The assumption can be broken down into further assumptions.

Loss resistance in a lossless wire above a lossy ground equals radiation resistance above a perfectly conducting ground plus induced loss resistance above a lossy ground.

In most cases of a short low antenna above a lossy ground where the wire is also lossy, the induced loss will be the greater. A further rash assumption is made. It is likely that the resistance of a lossless antenna above a very lossy ground will be somewhere about its free space resistance, leading to the further rash breakdowns. Efficiency of a lossless antenna above a lossy ground = resistance above a lossless ground ÷ radiation resistance in free space. Therefore actual efficiency of a horizontal antenna = radiation resistance above a lossless ground ÷ (radiation resistance in free space + wire loss resistance).

Note.—It is not intended that the above should be applied to a high, resonant antenna.

From the latter rash formula it is apparent that the efficiency cannot be greater than the ratio given in the former formula.

The above rash conclusions are offered as a guide to anyone who wishes to test them in practice. If anyone can provide a complete practical analysis of the above they are welcome to try, but who but a Radio Amateur would try to use a short low antenna above a lossy ground.

Conclusions from Results

1. The efficiency of a vertical antenna is fairly easy to determine.
2. It is suggested that the efficiency of a horizontal antenna can be determined in a similar manner.
3. The results have been cross checked with results in practice and would appear to be correct.
4. The comparison between the efficiency of the horizontal and the vertical is useful in determining the area in which the horizontal would have advantage over the vertical.
5. In short range work, outside the surface wave area, it is greatly advantageous to have a choice of a vertical or a horizontal antenna. The doublet centre fed with open wire feed line provides the best answer since it can be used in either configuration.

REFERENCE

5. Radiotron Designers' Handbook. Conversion from series to parallel impedance, p. 157.

ANTARCTICA RESEARCH

Further to the paragraph in July "A.R." page 32, the tentative programme for the proposed Symposium includes (a) a review of communications requirements and statement of main practical difficulties affecting fixed and mobile (including position determination by radio) services within Antarctica and externally thereto and therefrom; (b) operational technical problems (co-ordination, maintenance, antennas, noise, snow static); (c) review of advantages and disadvantages of various transmission media (all frequencies and scatter), and use of satellites; (d) scientific results and developments likely to improve Antarctica communications and consideration of papers thereon (predictions, scatter, propagation, antennas in snow, poor earth, unmanned stations, modulation and data systems, etc.), and ending with policy and cost discussions and recommendations.

INDONESIA LICENSING

Notes from VK2AOK received from YB0BY

The Central A.R. organisation is:—
Organisasi Radio Amatir,
Republik Indonesia (O.R.A.R.I.)
Djl Lembang 41,
P.O. Box 2761, Djakarta,
Republic of Indonesia.

YB0—The capital Djakarta.
YB1—W. part of Java Is., Box 288, Bandung.
YB2—C. part Java Is., C/o. YB2AB, Samarang.*
YB3—E. part Java Is., C/o. YB3BT, Surabaya.*
YB4—S. part Sumatra Is., C/o. YB4GA, Palembang.*
YB5—W. part Sumatra Is., C/o. YB5AI, Padang.*
YB6—N. part Sumatra Is., C/o. YB6JA, Medan.*
YB7—Bornea Is. (Indonesian part).
YB8—Moluccas (Celebes, etc.).
YB9—Bali to West Irian.

* Addresses are available.

LICENSED AMATEURS IN VK

MARCH 1971

	Full	Lim.	Total
VK0	11	1	12
VK1	84	29	113
VK2	1403	471	1874
VK3	1319	652	1971
VK4	520	197	717
VK5	518	234	752
VK6	361	137	498
VK7	160	66	226
VK8	35	14	49
VK9	91	10	101
Grand Total	4502	1811	6313

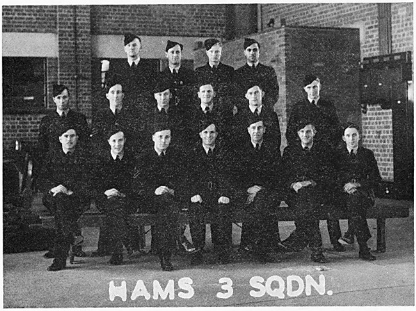
W.I.A. BROADCASTS

7146 KHz.

VK2WI, Sundays, 1100 hrs. E.A.S.T.
VK3WI, Sundays, 1030 hrs. E.A.S.T.
VK4WI, Sundays, 0900 hrs. E.A.S.T.
VK5WI, Sundays, 0900 hrs. C.A.S.T.
VK6WI, Sundays, 0930 hrs. W.A.S.T.
VK7WI, Sundays, 1000 hrs. E.A.S.T.

AUSTRALIAN FLYING CORPS No. 1 SQUADRON IN EGYPT 1917

In foreground, with cane, is Major Richard Williams, who will be giving the opening address for the R.D. Contest as Air Marshal Sir Richard Williams, K.B.E., C.B., D.S.O., R.A.A.F. (retd.) (Photograph by courtesy of R.A.A.F.)



3 SQUADRON AMATEURS AT RICHMOND, N.S.W., 15th July, 1940

Back (left to right): John Parr, VK3OM; Ned White, VK2HA; Ron Horne, VK4RR; J. Perooz, VK2PE.
Centre: Frank Carey, VK2AMI; Bill Smith, VK2BS; George Fenton, VK2GV; Snow Campbell, VK3MR; George Curl, VK2AJB/VK6NO (Silent Key); Jim Edwards, VK2AKE.
Front: Ken Williams, VK2XD; Arthur Wignell, VK2ALK (Silent Key); Rex Corthorn, VK2VG, now VK3VG; Vic Jarvis, VK2VJ (Silent Key); Ern Catt, VK2FU; Daddy Gibson, VK2GH; and Geoff Thornton, VK2IP.
Not in photograph: Ted Aked, VK2AEU; Tim Teehan (ZL) (Silent Key).

NEW CALL SIGNS

MARCH 1971

VK1GC—G. Cochrane, 37 Devonport St., Lyons, 2606.
VK1SR—S. N. Graves, 26 Glynn Pl., Hughes, 2605.
VK1ZSR—R. B. Staddon, 11 Melrose Dr., Mawson, 2607.
VK2QC—F. A. O'Donnell, 20 Wood Rd., Griffith, 2680.
VK2WZ—W. G. Rayner, 12 Barrawarn Pl., Castle Hill, 2154.
VK2XJ—D. P. Wickens, 53 Hill St., Roseville, 2069.
VK2YK—E. J. Pickles, 106/61 Osborne Rd., Manly, 2095.
VK2BAG—A. R. Eckersley, 46 Alexander St., Smithfield, 2164.
VK2BCV—A. H. Sandilands, 5/29 Mimosa St., South Bexley, 2207.
VK2BDM—D. Miller, 1/27 Aubin St., Neutral Bay, 2089.
VK2BDV—S. S. Durland, 3/100 Wallis St., Woollahra, 2025.
VK2BET—E. Trimingham, 149 Somerville Rd., Hornsby Heights, 2077.
VK2BGV—G. Voron, 7/30 Arcadia St., Coogee, 2034.
VK2BGW—R. W. Grouse, 63 Wattle Ave., Macquarie Fields, 2564.
VK2BME—J. Mack, 78 The Crescent, Cheltenham, 2119.
VK2BMM—M. S. McKenzie, 16 George St., Penshurst, 2222.
VK2BPC—P. J. Corbett, 2/33 Fifth Ave., Campsie, 2194.
VK2BQA—E. Garrett, 5 Balyata Ave., Caringbah, 2229.
VK2BQF—A. Greenberg, C/o. A. Slutzin, 295B Edgecliff Rd., Woollahra, 2025.
VK2BQG—M. Greenberg, C/o. A. Slutzin, 295B Edgecliff Rd., Woollahra, 2025.
VK2BXA—J. Linden, 513 Webb St., Lavington, 2641.
VK2ZCM—C. Mugdan, 34 Lochville St., Wahroonga, 2076.
VK2ZJD—J. Davis, 4/14 Princes H'way, West Wollongong, 2500.
VK2ZKY—J. S. Shenstone, 14 Broughton Rd., Homebush, 2140.
VK2ZQZ—S. M. Garnham, Jilliby Rd., Wyong, 2259.
VK2ZRS—R. S. Shepherd, "Wyuna," Culargambone, 2828.
VK2ZRX—W. S. Baynes, 10/42 Orpington St., Ashfield, 2131.
VK2ZSN—N. K. Showell, 25 William St., Keirville, 2500.
VK2ZUW—R. R. Alexander, 62 Pass Rd., Thirroul, 2515.
VK2ZVD—J. J. Van Dan Bogert, 32 Bilga St., Kirrawee, 2232.
VK2ZVI—R. F. Worthington, 65 River St., Cundletown, 2430.
VK2ZZN—D. G. Rowe, 57 Carlingford Rd., Epping, 2121.
VK2ZZX—R. W. Nash, 62 Haigh St., Maroubra, 2035.
VK3CR—R. J. Flanagan, 51 Valetta St., Carrum, 3197.
VK3MM—M. P. Marschall, 2 Parker St., Regent, 3072.
VK3SB—W. Yates, 1 Oswald St., Cheltenham, 3192.
VK3ZU—R. Dorin, 12 Oleander St., Glen Waverley, 3150.
VK3ADT—K. V. Brayshaw, 89 Roslyn St., Burwood, 3125.
VK3AXE—K. G. McCracken, 13 Malcolm Crt., Mt. Waverley, 3149.
VK3BAS—P. R. Dickson, 6 Murray St., Bendigo, 3550.
VK3BCB—Christian Bros. College, 385 Queensberry St., North Melbourne, 3051.
VK3BGL/R2—Geelong Amateur Radio Translator Group, Station: "Bayview," Haines Rd., Gnarwarre; Postal: 5 Kyle Ave., Belmont, 3216.
VK3CDX—J. E. Forster, 8 Bristow Ave., Forest Hills, 3131.
VK3YFI—J. E. Leitch, 34 Hill St., Box Hill South, 3128.
VK3YFR—A. E. Fraser, 28 Deakin St., Mitcham, 3132.
VK3ZGU—G. S. Cooper, 8 Norwood Crt., Bundoora, 3083.
VK4HU—F. C. Hutton, Middle Creek, via Pomona, 4568.
VK4OY—J. C. A. Young, 6 Koombala St., Tugun, 4224.
VK4QK—C. M. Cohen, 105 Waterview Ave., Wynnum, 4178.
VK4ZFS—F. V. Sharpe, 138 Adelaide St., Clayfield, 4011.
VK5QJ—J. C. Hulse, C/o. Adelaide Bible Institute, Mt. Breckan, Victor Harbor, 5211.
VK5UN/T—W. J. Emmett, C/o. McPhar Geophysics, 50 Mary St., Unley, 5061.
VK5ZFY—F. Richelme, 12/12 Howard St., Underdale, 5032.
VK5ZLH—H. L. Day, 7 Piccadilly Circuit, Colonel Light Gardens, 5041.
VK6BX—B. A. Cook, 28 Pier St., East Fremantle, 6158.
VK6JX—J. A. Large, 6 Hann Court, 46 Cape St., Osborne Park, 6017.
VK6MJ—J. K. Millband, 11 Salisbury St., Cottesloe, 6011.
VK6ZBB—W. E. Olson, Lot 8, Morrison Rd., Upper Swan, 6056.
VK7GW—G. A. W. Wood, 8 Norwood Ave., Launceston, 7250.
VK7ZGT—G. L. Thomson, 131 Westbury Rd., Launceston, 7250.

CANCELLATIONS

VK2ASR—S. N. Graves. Now VK1SR.
VK2BFD—F. A. O'Donnell. Now VK2QC.
VK2ZUO—W. G. Rayner. Now VK2WZ.
VK3AEU—R. J. Flanagan. Now VK3CR.
VK3AHS—W. Yates. Now VK3SB.
VK3AIY—R. Dorin. Now VK3ZU.
VK3AUH—R. R. Hooper. Now VK9HL.
VK3BFB—Geelong Amateur Radio Translator Group. Now VK3BGL/R2.
VK3ZQE—J. A. Evans. Not renewed.
VK4EP—P. Ellis (Rev. Bro.). Transferred to Vic.
VK4GZ—E. M. Waddle. Deceased.
VK4MS—W. R. McLaughlin. Deceased.
VK4PM—J. G. Porter. Not renewed.
VK4XI—D. D. Kinnersley. Not renewed.
VK4ZLL—L. Labruyerg. Transferred to N.S.W.
VK4ZSR—G. R. Sallaway. Not renewed.
VK4ZTC—A. J. Crane. Transferred to Vic.
VK5AN—J. W. Emmel. Not renewed.
VK5BP—1st Gawler Scout Group. Not renewed.
VK5DZ—M. J. Groth. Transferred to N.Z.
VK5JY—J. N. Combe. Not renewed.
VK5ZNR—G. J. Simmons. Not renewed.
VK5ZWR—W. R. Chapman. Transferred to N.S.W.
VK6FR—R. F. Frost. Transferred Interstate.
VK6IW—A. F. Wreford. Not renewed.
VK6TJ—A. C. Gray. Not renewed.
VK6YL—A. Clowes (Mrs.). Not renewed.
VK6ZEK—J. P. Hughes. Not renewed.
VK7JF—J. E. Forster. Now VK3CDX.
VK7ZFM—F. Richelme. Now VK5ZFY.
VK7ZGP—G. P. Power. Not renewed.
VK7ZGW—G. A. W. Wood. Now VK7GW.
VK7ZNR—A. N. Richardson. Transferred to Vic.
VK8AG—L. B. Burston. Transferred to N.S.W.
VK8DS—D. C. Skeen. Not renewed.

APRIL 1971

VK2GB—R. S. Coote, 26 Clontarf St., Seaforth, 2092.
VK2AAC—A. F. Cutting, 7/2 Andover St., Carlton, 2218.
VK2BEO—M. Greenberg, C/o. 295B, Edgecliff Rd., Woollahra, 2025.
VK2BMJ—J. H. Mowtell, 16 Ian St., Rose Bay, 2029.
VK2BTR—W. T. Rice, 17 Minerva St., Sutherland, 2232.
VK2YK—A. Greenberg, C/o. 295B, Edgecliff Rd., Woollahra, 2025.
VK2ZLY—L. Labruyere, 9E Elizabeth Bay Gardens, 15-19 Onslow Ave., Elizabeth Bay, 2011.
VK2ZRY—E. W. Reynolds, 111 Northcliff Dr., Lake Heights, 2502.
VK2ZTU—K. M. Tuck, 318 Vallombrose St., Albury, 2640.
VK2ZWZ—W. R. Chapman, 167 Gypsum St., Broken Hill, 2880.
VK3AHH—R. F. Frost, 40 Tudor St., South Oakleigh, 3167.
VK3AUY—S. A. Sibly, 17 Luck St., Eltham, 3095.
VK3BAU—B. A. Austin, R.A.A.F. Base, Laverton, 3027.
VK3BBU—P. B. Parry, 12 Milverton St., Moonee Ponds, 3039.
VK3BDJ—D. J. Bainbridge, 23 Locke St., Essendon, 3040.
VK3BFG—P. J. Cossins, 14 Coleman Rd., Wantirna South, 3152.
VK3BFH—R. L. Lemke, 5 Echuca St., Bendigo, 3550.
VK3BFI—P. Ellis (Rev. Bro.), St. Patrick's College, Ballarat, 3350.
VK3BJB—J. E. Beevers (Mrs.), 11th St., Mildura West, 3500.
VK3YFK—D. P. Ramsey, 19/43 Caroline St., South Yarra, 3141.
VK3YFM—C. J. Heath, Tower Motors, Morrissey St., Merrigum, 3618.
VK3YFN—C. A. Milhuisen, 34 Brinsley Rd., Camberwell, 3124.
VK3YFO—W. D. Miles, 255 Burwood H'way, East Burwood, 3151.
VK3YFP—J. F. Topp, 29 Clifton St., Richmond, 3121.
VK3ZGG—C. H. Robertson, 105 The Boulevarde, Thomastown, 3074.
VK3ZLO—R. W. Davis, 69 Jubilee St., Mt. Waverley, 3149.
VK3ZYL—R. A. Piner, 13 Sheales St., Dandenong, 3175.
VK4NX—H. M. Bone, 65 Rosemont Ave., Moana Park, Surfers Paradise, 4217.
VK4UM—R. S. Morton, 17 Crown St., Toowoomba, 4350.
VK4XQ—H. N. Starr, 101 Stanhill Dr., Chevron Island, Surfers Paradise, 4217.
VK4ZHT—V. Husin, 3 Elmfield St., Upper Mt. Gravatt, 4122.
VK4ZNH—N. H. Eberhardt, 75 Figtree Pocket Rd., Chappel Hill, 4069.
VK4ZNR—R. N. Boland, 44 Birch St., Cairns, 4870.
VK5DA—D. G. Aslin, 65 Wehl St., North Mt. Gambier, 5290.
VK5PJ—Port Augusta Youth Radio Club, P.O. Box 15, Port Augusta, 5700.
VK5PV—J. J. Roos, Flat 218, Block 2-B, Wirruna St., Woomera, 5720.
VK5QA—F. T. Wilson, 3/22 Airport Rd., Brooklyn Park, 5032.
VK5UH—R. E. Lewis, Flat 257, Block 2-E, Carinya St., Woomera, 5720.
VK5UO—D. E. Wikstrom, Weapons Research Establishment, Mess Club, Woomera, 5720.
VK6HU—P. V. Hughes, 58 Preston St., Como, 6152.
VK6HV—H. K. F. Vun, 30 York St., Tuart Hill, 6060.
VK6II—29 DX Club of W.A., C/o. Hon. Sec., 12 Munyard Way, Morley, 6062.
VK6JZ—J. Garratt, C/o. 67 Hennessy Ave., Orelia, 6167.
VK6OD—D. E. Pfranger, 23 Kennedy St., Exmouth, 6707.
VK6OZ—A. R. Vanston, Lot 2, Ivanhoe St., Morley, 6062.
VK6PS—Perth Modern Senior School Radio Club, Roberts Rd., Subiaco, 6008.
VK6SU—L. R. Glatt, Station: U.S. Navacom Stn., Exmouth; Postal: P.O. Box 20, Exmouth, 6707.
VK6WO—R. T. R. Norcross, 33 Caladenia Way, Koongamia, 6056.
VK6ZBT—C. J. Duddington, Station: White Rd., Narrogin; Postal: P.O. Box 151, Narrogin, 6312.
VK6ZEF—R. J. Wynn, 58 Clayton St., East Fremantle, 6153.
VK6ZKL—R. P. Lockley, 96 Waddell Rd., Bicton, 6157.
VK7GN—D. A. J. Menzies, 332 West Tamar Rd., Riverside, 7250.
VK8GY/T—G. L. Tillett, 1/6 Hong St., Alice Springs, 5750.
VK8SS—S. A. Stephens, 55 Carruthers Cres., Alice Springs, 5750.
VK9AZ—Posts and Telegraphs Training College Radio Club, Racecourse Rd., Boroko, P.
VK9JM—J. R. Meehan, Montport Mission, Kiung, W.P., T.P.N.G.

CANCELLATIONS

VK2OZ—A. R. Vanston. Now VK6OZ.
VK2RW—R. W. M. Cusiter. Deceased.
VK2ASY—D. K. W. Bradbury. Transferred to Vic.
VK2BQF—A. Greenberg. Now VK2BYK.
VK2BQG—M. Greenberg. Now VK2BEO.
VK2ZWP—W. T. Rice. Now VK2BTR.
VK3CN—L. C. Walters. Not renewed.
VK3XX—C. W. Jamieson. Not renewed.
VK3AFE—B. F. Huggard. Transferred to N.Z.
VK3BAW—E. A. Williams. Not renewed.
VK3BCD—E. G. Egan. Not renewed.
VK3BCR—H. G. Austin. Not renewed.
VK3YEK—J. E. Beevers (Mrs.). Now VK3BJB.
VK3ZRX—D. M. Bennett. Not renewed.
VK3ZVT—D. S. Thomas. Transferred to A.C.T.
VK4FM—F. P. Moody. Not renewed.
VK4FW—L. R. Woolley. Deceased.
VK4ZBQ—C. P. O'Brien. Not renewed.
VK4ZMS—R. S. Morton. Now VK4UM.
VK4ZWD—W. D. Metcalfe. Not renewed.
VK5GY—T. P. Gardner. Not renewed.
VK5SI—W. O. B. Wilson. Transferred to A.C.T.
VK5ZEQ—R. G. Gully. Not renewed.
VK5ZER—D. G. Aslin. Now VK5DA.
VK6KV—D. T. Lysle. Not renewed.
VK6TG—E. G. Gabriel. Not renewed.
VK6ZGI—Perth Modern Senior High School Radio Club. Now VK6PS.
VK7RO—R. E. Rogers. Not renewed.
VK8ZGY—G. L. Tillett. Now VK8GY.
VK8ZSS—S. A. Stephens. Now VK8SS.
VK9AQ—N. A. Miller. Returned to mainland.

R.D. CONTEST

14th and 15th AUGUST, 1971

ALL SET TO GO?

Opening address by Air Marshal Sir Richard Williams, K.B.E., C.B., D.S.O., R.A.A.F. (Retd.)

Overseas Magazine Review

This is different but it uses material supplied by VK3ASC and VK7RG.
Any comments? See end for key.

ANTENNAE: Simple vertical arrays (6); plain facts for tyro and beginner (also feeders and trans-matches) (6); wet string falacy (7); 160 mx centre-loaded whip (17); compact verticals (16); portable (4); Kirk helicoidal beams (11); G4ZU single boom (10); 2 mx parallel fed vertical collinear (9); microwave paraboloids (3).

MASTS: A-frame (4); 10 extra feet on the tower (13).

ROTATORS: Simple (perhaps too simple) (1); delayed action braking (6).

CHANGE-OVER APPL.: Sol. state switch (8).

TRANSMITTERS: Beginners' 1-valve high power (7); transistor 12w. for 10 mx (12); solid state 10 mx d.s.b. (13); power level comparisons (15); p.c.b. ATK-2 modulator (18); lazy man's v.f.o. for 2 mx (11); stability without xtals with solid state module (12); "rubber" xtals (18); digital proportional radio control (10); advanced pre-amp. compressor clipper (13); power FETs (15); tripler 70 cm. (17); tripler to 23 cm. (18); 160 mx s.s.b. transverter from 40 mx (18).

RECEIVERS: Latest techniques in new design "plagiarise and hybridise" (2 to 5); direct conversion heterodyne (8); freq. counter (6); xtal calibrator (13); Drake 2B mod. for 160 mx (17); R1155 modernising (18); AR88 S meter (3, 5); SB303 review (10); r.t.t.y. converter (6); re-vamping old rx (11); xtal WWV for Swan Cygnet (9); FET for a.m. b.c. rx (6); noise blankers (9, 12); solid state preselectors (12); FET dual gate pre-amp. for 2 mx (13).

TRANSCEIVERS: One-tube cheap 2 mx (13); ZL2BDB tribanders (8); 2 mx f.m. (12); SIC for s.s.b. and a.m. (5); HW100 mods. (1); H23 handi-talkie mods. (12); FT200 review (11); Drake TR3 break-in c.w. mod. (11).

AMPLIFIERS: Switching remote linears (12); low power design concepts (13); high power for 80-10 mx (15); higher power tripler for 70 cm. (2); 500w. 2 mx pentode linear (9); grounded grid pair 813s (3); using SL610/12 r.f. (1); ensuring transistor stability (1).

REPEATERS: (12 to 15).

KEYERS: IC (8, 17); touch-coder one-letter memory (6).

POWER SUPPLIES: Auto current overload protection (8); solid state protective devices (10); SCR regulated (19); dual input design (8).

TEST EQUIP.: All sorter tester (3); simple r.f. wattmeter (7); simple freq. std. (4); noise generator (2); f.m. low cost vxo signal source (12); meter evaluator (12); simple s.w.r. device (18); r.f. magnetometer and f.s. meter (10, 11).

F.M.: Newcomer tips (10); advantages (12); U.S.A. stds. (12); transceiver directory (13); simple circuit (18); simple varactor modulator (12); n.b. 455 KHz. discriminator (1).

MOBILE: Camper installation (10).

INTERFERENCE: Recognising f.m. intruder signals (6); t.v. (15).

T.V.: Slow scan techniques (1).

PROPAGATION: Tropospheric 2 mx study (18).

SATELLITES: Reception (2, 16, 17).

MICROWAVES: (1 to 5, 12, 18).

COMPONENTS: Variable capacitor do's and don'ts (2); compact band-pass filter for 2 mx (5); low-pass filter for F.D. (8); tuning diodes (9); v.h.f./u.h.f. practical coil winding date (15); ferrite inductors (15); DIY "computer" (19); f.m. net alert bell (11).

OTHER: Blind operators' aid (11); graphs of power, volts, impedance (15); FET symbols (19); cheap 24-hr. digital clock (3); dry cells re-charger (looks interesting) (5).

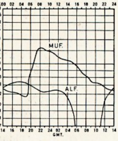
KEY (all are 1971)

"Radio Communications": Feb. (1), Mar. (2), Apr. (3), May (4), June (5).
"QST": May (6).
"Break-In": Apr. (7), May (8).
"CQ": Mar. (9), Apr. (10), May (11).
"73": Apr. (12), May (13).
"Ham Radio": Mar. (14), Apr. (15).
"Short Wave Mag.": Feb. (16), Mar. (17), Apr. (18).
"Aust. E.E.B.": Mar.-Apr. (19).

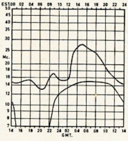
PREDICTION CHARTS FOR AUGUST 1971

(Prediction Charts by courtesy of Ionospheric Prediction Service)

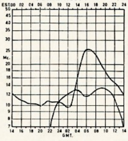
BARBADOS



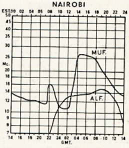
CAIRO



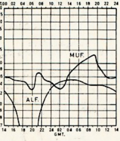
JOHANNESBURG



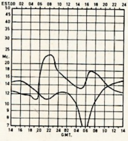
NAIROBI



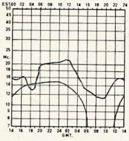
LONDON S.R.



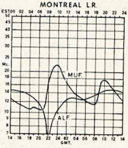
LONDON L.R.



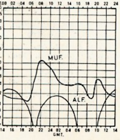
MONTREAL S.R.



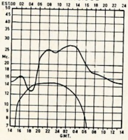
MONTREAL L.R.



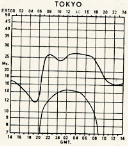
RIO DE JANEIRO



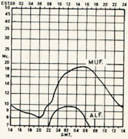
SAN FRANCISCO



TOKYO



WILKES



OBSERVATION POST

By H. F. Evertick

We seem to have very little exchange of news about visiting Amateurs to our shores. Is this symptomatic of something? Extremely knowledgable and interesting recent visitors who come to mind are WA6FSC (VR5DK, ZL1ATC, 3B9DK), ZL2AMJ, VP9DC, G3UJB, G2FUX, CE6DR, SM5DEQ, VU2JD, VU2OV and K2IXP.

Perhaps, of greater interest to the reader than those who have been here are those who will be visiting Australia. There is, then, a fair chance that we can welcome our visitors with a measure of hospitality, twist their arms to give a group talk perhaps and generally to exchange a yarn or two. Is there a feeling that news of visits must be jealously guarded?—"He is my friend, I will not share his company with any Tom, Dick or Harry"; "I alone will take pleasure in sharing his pleasure of new scenes and fresh faces". Or is it perhaps apathy? "I have my own group of friends, to heck with strangers." "Too busy." Shy? Afraid of him patting your pocket-book perhaps?

Most of us were brought up in the true Amateur spirit. Is there any real difference between talking to "Bob" over the air and an "eye ball" when he is a visitor? If you visit Timbucto or Athens, would you like to meet the local Amateurs in a friendly way?

Would we, therefore, like to have news of visitors who plan to be with us for a brief moment in time? As a starter, a panel is appended. Why not write in when you know about visitors shortly to arrive. Many of us can then join in with a welcome of some kind—be it ever so humble.

Although the Amateurs' interests seem limitless, many of the DX fraternity speak in glowing terms of our wonderful country. No better tourist ambassadors could be found anywhere.. In this way they take pleasure in persuading overseas Amateurs to visit Australia or even local Amateurs to visit places they would otherwise bypass. Very excellent contacts are made, good friends are acquired and the talk even encompasses such things as the unique quality of the red and black soils of the Downs.

Some people have asked if we can and should do more. For example, sending to ships and radio officers aboard ship a printed note of how to contact a local Amateur or local groups for the benefit of the travelling Amateur. Most of these would welcome a few hours ashore next to a rig in congenial company or even some advice on what sight-seeing should be done. Most of them would jump at the idea of a contact "back home". Is there a need for a visitors' column? Write to the Editor and we shall soon see.

VISITING AUSTRALIA

9J2HE—During September
M.V. "Canberra"
Perth, eastwards.

GOLDEN JUBILEE

Congratulations! and Many More Happy Days to VK4DO for 50 Years in Amateur Radio

Hal Hobler, North Rockhampton, built his first crystal set in 1921 and has progressed from a 1923 10-watt 240 metre R/T rig made out of completely home-made components (except the valves) using a coupled Hartley oscillator and loop (absorption) modulation right through to the present day s.s.b. gear with home-brew power supplies.

The receivers included a "lo-loss" 2-valve model with a quarter inch plate glass panel, the holes of which had to be drilled with rat-tail files.

Antennae in use are a 2 el. quad for 14 MHz., a dipole for 7 MHz. and a 3 el. yagi on 53 MHz. which, with a converted ex taxiphone, is used for JA contacts when openings occur.

Hal considers the W.A.Z. certificate the highest award in Amateur Radio—he has three: c.w., a.m. and s.s.b.

In 1926 he made two-way contacts with the U.S.A. using 140v. on a 201A rx tube and was heard in ZL on phone. W.A.C. in 1936 was made in 50 minutes with 48 watts and on phone in 1948 in 28 minutes.

The holder of numerous Awards—going back to 1924—Hal is active in the R.D. and VK-ZL contests. His most difficult things to do in Amateur Radio? To copy a 500-word c.w. Trans-Pacific Test message in 1926 and to get QSL cards from Zone 23 before the JTs went there.

☆

FEDERAL CONTEST COMMITTEE

For the past six years the Federal Contest Committee has been located in Perth, Western Australia under the leadership of the Federal Contest Manager, Neil Penfold, VK6ZDK. Neil and his group have done an excellent job as members will know, but the time has come for a change.

At the last Federal Convention the Queensland Division volunteered to take over the administration of our Contests and the VK4 Federal Councillor has now advised that his Division has appointed Peter Brown, VK4PJ, as the new Federal Contest Manager. Peter's address becomes—

FEDERAL CONTEST MANAGER,
G.P.O. BOX 638,
BRISBANE, QLD., 4001,

and logs for all local Contests will go to G.P.O. Box 638 for the next three years at least. However, VK6ZDK will, for the present, remain administrator for the VK/ZL Contest and consequently contestants should look carefully at the rules to determine the correct address for their Contest logs.

Correspondence

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

NOVICE LICENCE

Editor "A.R.," Dear Sir,

In the letter in July "A.R." from VK3RN, he makes a brief reference to frequency allocations proposed by the committee pressing for the introduction of Novice licensing. The reference is on page 127, para j.

I would like to go much further than talking about 160 metres and amplify the remarks he makes on 160 metres to the other h.f. bands. To my mind, there has been complete "Novice" thinking by the committee, especially as they have been so keen to use U.S. Amateur Radio as examples.

The recommendation of the allocation of the lower end of all h.f. bands is ludicrous, and surely is used to try and get the experienced DXers jammed into a small portion of the DX bands. If the committee say this is not so, let me make two points to show the impracticability of the proposal.

(a) On 3.5 MHz. for example, the Novice has 3505 to 3525 KHz., leaving the experienced DXer 3500-3505 only, if the regulations give the Novice that spectrum. The DXer will, of course, not be confined to that 5 KHz., and because he will have high class receiving equipment, unless very local, the Novice will not cause him much trouble. On the opposite side, the Novice will probably have only a simple receiver, incapable of handling the amount of interference received from the DXer chasing his 5-band DXCC, or working his regular "skeds". The result: he closes down.

(b) The present licensing procedure in the U.S. precludes thousands of Amateurs in the States from operating below 25 KHz. on any of the bands 3.5 to 28 MHz. Therefore Australian Amateurs, and of course, all other countries, will regularly be operating above the first 25 KHz. of any of the above bands and, accordingly, force the Novice, solely because of lack of experience and operating ability to close down. How much would he copy through a station operating at 25 w.p.m. or even higher.

In my discussion with Rex Black on Novice licensing, at no time did he mention the frequency spectrum proposed for them, otherwise I would have pointed out the futility of proceeding with the idea that has emerged.

It amazes me to think that instead of encouragement to get on the bands, a proposal is made that will do nothing but discourage them to get on the h.f. bands, and as a result make for discontent.

—F. T. Hine, VK2QL.

* * *

Editor "A.R.," Dear Sir,

I have been following the discussions about Novice licences with interest and wish to place on record that I favour the introduction of this type of licence. Having read in another radio magazine about the general types of conditions which might be considered. I can see such a Novice licence as a useful aid in the instruction which I provide to a local Y.R.C.S. Group.

First, I think that my holding a Novice licence as the Group Leader would add some prestige to my training efforts. Second, I can look forward to some of my class progressing to the Novice standard and joining with me in regular "skeds" and so gaining experience under my supervision before being let loose to contact other Novices and other Amateur operators. Third, I feel that lads who have had Novice training will turn out better Morse operators than those who just gain the A.O.C.P. under present licensing and examination conditions. Fourth, I can see the advantage of a Novice licence as a way for older people to enter the Amateur Radio hobby. Fifth, I think that the local adult radio club would benefit by increasing its membership if it contained a group of Novice operators as well as the present A.O.C.P., Limited (Z call), and S.w.l. members.

—Gordon Procter,
Y.R.C.S. Group Leader, Gosford.

* * *

Following is a precis of a letter from Mr. Karol Nod, ex OK3UH, of Sydney:

I agree that pros and cons must be considered, so far we have only heard the arguments for it.

We are a very slow and unprogressive people in this matter. It seems that the top operators are afraid of Novice licensing—for what reason? If the Novice operator causes QRM or interference to yourself, please teach him better ways.

Those of us who hope to see Novice licensing in the Amateur Service would like it to apply to the young and the old, and thus reviving c.w. net activities. Novices will surely bring a new breed of operators back into the c.w. parts of the bands who would stay with the mode.

Having read VK3RN's article there is no problem about the disposal of the equipment in the Novice's possession after the year end—it would be sold, dismantled or used in VK-QRP contests. A Novice licence will not bring additional people into the Amateur fraternity.

Finally, I think the full licensee must show more friendliness to the beginner by wise counsel and advice in the true Amateur spirit. The air should not be used by some for their own amusement at the expense of others' pleasure.

SPX BULLETINS

The SPX Bulletins are issued bi-weekly by the IUWDS World Warning Agency for Satellites at the World Date Centre A for Rockets and Satellites, Code 601, Goddard Space Flight Centre, Greenbelt, Maryland, 20771, U.S.A., and are distributed regularly to the COSPAR National Spacewarn contacts for satellite information and to Satellite Warning Centres for their further distribution to interested institutions in their countries or regions.

Paragraphs A and B of these Bulletins are not being reproduced as they would duplicate the list given in Section 1 of the Survey of Satellites and Space Probes. Paragraph C hereunder contains information not previously published in the Bulletin. This information is being included regularly in each issue of the Bulletin.

"C"—SPACECRAFT PARTICULARLY SUITED FOR INTERNATIONAL PARTICIPATION (Category I)

1. **Spacecraft with essentially continuous radio beacons on frequencies less than 100 MHz., or higher frequencies if especially suited for ionospheric or geodetic studies** (* denotes new information).

Designation National Name	Frequency (MHz.)	Reference in COSPAR Info. Bulletins
1965-032A Explorer 27	Feb. 14, 1970: 20, 40, 41 (250 milliwatts); also 360 (100 milliwatts); also 162 and 324	
*1966-110A ATS 1	Oct. 11, 1970: 0000 UT at 148.885°W, 1.351°N, drifting 0.015°/day. Inclination 2.846°; 136.47; 137.35 (2 watts)	37, p. 35
*1967-111A ATS 3	Oct. 11, 1970: 0000 UT at 63.544°W, 0.820°S, drifting 0.014°/day. Inclination 1.117	44, p. 68
1968-002A Explorer 36 (GEOS-B)	162, 324, 972 (300, 400 and 500 milliwatts)	49, p. 41
1968-069A ESSA 7	136.77 at 250 milliwatts	46, p. 42
1968-084A Aurorae	136.170 at 0.2 watt	47, p. 32
1968-100B TTS 2	136.86 at 100 milliwatts	48, p. 37
1968-110A OAO 2	136.441 at 160 milliwatts	48, p. 38
1968-114A ESSA 8	136.770 at 250 milliwatts	48, p. 39

2. **Satellites which provide telemetered information on a continuing basis** (* denotes new information).

Designation National Name	Freq. (MHz.)	Details	Reference in COSPAR Info. Bulletins
*1966-016A ESSA 2	137.50	Deactivated Oct. 10, 1970	35, p. 43
1968-017A Explorer 37	136.521 137.590 (150 mW.)	(x-rays) spin rate is 55-60 rev. min., aspect angle is controlled between plus or minus 5°	46, p. 35
*1968-114A ESSA 8	137.620	APT-8-picture sequence starting at 58°N descending, providing coverage on entire sunlit portion of earth	48, p. 39
*1969-037A Nimbus 3	136.95	APT has been programmed off due to spacecraft attitude problems	50, p. 55
1970-008A ITOS 1	136.77 137.5	Tracking beacon (250 mW.) APT (5 watts). Up to an 11-picture sequence starting at 59°S ascending, providing coverage over the sunlit portion of the earth. An APT station can receive up to four pictures in a single pass	53, p. 39
*1970-025A Nimbus 4	136.95	APT (5 watts). Remains off due to power conflicts with other experiments on board	54, p. 28

3. **Optical objects used for geophysical studies.** (Also suitable for air density studies.) Additional research interest is indicated by † for gravitational field, and § for rotational speed of atmosphere.

		Priority			Priority
†1961-001A	NNN	3	§†1967-042A	Ariel 3	3
1963-030D	NNN	6	†1968-090A	Cosmos 248	3
†1964-053A	Cosmos 44	5	§1969-108A	Cosmos 316	1
§†1966-044A	Explorer 32	8	§1970-043B	Cosmos 347	2
1966-056A	PAGEOS 1	6			

4. **Satellites useful for simultaneous observation programmes with small cameras.**

		Incl.	Per. (km.)	Ap. (km.)	Magn.	Remarks
1963-049A	NNN	90	1070	1090	Plus 5	
1964-001A	NNN	70	920	930	Plus 5	cylinder, 8 x 1.5 m.
1964-053A	Cosmos	65	600	860	Plus 4	cylinder shape
1965-070F	Cosmos	56	1360	1510	Plus 5	rocket body
1965-073F	Cosmos	56	1380	1690	Plus 5	rocket body
1966-056A	PAGEOS 1	85	2640	5710	Plus 2	

(With acknowledgment to COSPAR Bulletin, Dec. 1970)

DX

By H. F. EVERTICK
C/o. P.O. Box 36, East Melbourne, Vic., 3002
(Times are in G.M.T.)

A plea for help. An answering call. But yours truly tackles this column this month without much aid from anyone at the time of going to press. Perhaps everyone is DX-ing on the square-eyed monster!

During June there were enough DX-peditions to satisfy most of the avid DX hunters and July seems no exception either. VK9NP portable Willis Island by Larry Pace and his merry men as set out in July "A.R." QSLs to K3RLY. Unfortunately sea conditions had deteriorated so much that the Mellish Reef trip did not eventuate. Operations from Willis were on all bands and the operating was first class.

Darleen WA6FSC, etc., passed through Melbourne and Perth early in June on her way to Mauritius where she was active as 3B8DK for a short spell before embarking for Rodriguez Island where she activated 3B9DK from the last week in the month. Troubles developed with the 15 mx part of the rig and the signals on 20 mx suffered for a time until the antenna was hoisted more into the air. She is due to leave Rodriguez late in July to continue her safari to 5Z4, 5X5 and the like. At the time of writing, a 5Z4 call seems possible, but the 5X5 might be a little doubtful although in the last few months licensing there has been restored. QSLs to VE6AKV.

Mention of 5X5 reminds me that 5X5NA is active from there. Uganda has become a rarity lately since the days of the VQ5s and even 5Z4 (previously VQ4) and 5H3 (ex VQ3) are now almost as rare as the former French Colonies in Africa. From that area 7Q7AA is heard spasmodically on 20, very infrequent 9J2s, seldom any 9U5s and 9X5s, the occasional 9Q5 but several CR6s, CR7s and ZEs.

Early in July the avid DXers had the pleasure (sic) of chasing Martin as 3C1EG on the Island of Fernando Poo in the Gulf of Guinea. Other areas activated by him were to be Equatorial Guinea and the Island of Annobon (possibly as 3C0ON).

Nearer home you will see elsewhere some notes on Indonesia. The addresses of some of the local representatives of O.R.A.R.I. are given as—

YB2AB—R. Imam Purwito, Djl, Argopuro No. 4, Samarang.
YB4GA—Johannes Titaley, Gg. Sumatara No. B-5, Palembang.
YB6JA—Dr. Soegito, Djl. Ampera No. 2, Kampus Universitas Sumut, Medan.
YC3BT—Aryanto, Djl. Indragiri No. 52, Surabaia.
YD5AI—Armeyn Ch., Djl. Pasar Raya No. 57, Padang.

Others shown on the lists were YB1s AG, AK, BH; YB2s AJ, AR; YB3DD, YB4GA, YB8SC, YB9UA and YB0s AE, AC, AT, BY and CJ. The lists were sent on by VK2AOK, for which many thanks. It is noted that expatriat's calls do not appear to have been listed.

An examination of the sunpot predictions shows that conditions on 10 mx will become extremely spasmodic, 15 mx will probably be open most of the time during daylight hours, 20 mx should be open during the day, sometimes at night, and deep dips to fade-out around sunset and sunrise, 40 mx average during the day but opening by darkness—if you can find the holes between the **Intruders.** 80 mx for locals during the day but opening well to all VK and ZL areas and beyond by night, and finally 160 mx opening at night. Several VKs worked through to KL7CL on 160 mx c.w.

Ample DX is still available. On 80 we miss out on the DX which congregates around 3790 KHz. On 40 5H3LV and a G or two came through well. On 15, Ws and JAs are still plentiful with 3B8CZ still consistent. On 20, there is ample DX for all and among the less frequent calls heard were (s.s.b.) EA8FF (Box 860, Las Palmas), CN8CG, EA9EJ (list by CR6FA), FK8AC, FO8DS, JD1ABO on Marcus Is. (QSL JA1BA), KS6DT (Dept. of Education, Pago Pago, Am. Samoa, 96920), KX6NR, PY0 DX-pedition to Trinade Is. not yet heard, VP-1AJ, VP2VI, ZD5F, ZL4OL/A on Campbell Is. (QSL ZL2GX) often on 80 mx, ZM7AG (QSL K3RLY), YJ8BJ (Bill, the Australian), YJ8BL (QSL W6NJU), 5Z4KL, 8P6AZ, 9G1FF, 9H1BX, 9M8SPD Mary (QSL Box 795 Kuching, Sarawak), 9N1MM (QSL K3WVQ), 9Y4VV.

QSL cards are now under circulation from the operation of VK0KB.

For PX hunters July should bring two new ones in KC2GMF, Great Mammoth Fair, Box 111, Freehold, N.J. 07728, and KC0KC, Box 753, Shawnee Mission, Kansas 66201.

A letter received from Mac VK9NI on Norfolk Is., takes issue with June "A.R." being incorrect. He says there are three, not one, of the Amateur fraternity resident on the Island and it is a Radio Amateur's paradise; anyone using the bands when open can expect a pile-up. The other two are of course VK9JA and VK9RH. Incidentally, VK3JF worked from Norfolk Is. from 23rd May to 6th June and greatly enjoyed his visit. I gather he worked s.s.b. and c.w., obtaining W.A.C. on both and experiencing very courteous pile-ups on c.w. He also said that a VK3 reckoned VK9 Norfolk Is. was not DX! John used a 14AVQ and reckons 4/5 weeks delay must be allowed for the issue of the licence.

For S.w.l's comes a note that the EDP system will introduce a change in the S.w.l. number by the addition of a 0 between the State numeral and the existing three numeral personal number: Thus SWL-L7777 will become SWL-L70777. This assumes that the EDP system has been fed with the correct number. So there could be some changes in the numbers which, I am told, the EDP processing boys wish to avoid particularly where S.w.l.'s have had cards printed.

Are you anti-list, pro-list or don't care? It seems there are demonstrators against everything if the performance on the afternoon of 10th June is any criterion. This probably resulted in ZK1MA going QRT, much to the chagrin of an enormous pile-up of Ws awaiting their turn to be called in by K6UFT as MC. The demonstrator, a VK2, did not work ZK1MA then either. He was too busy calling to hear the Ws having a quick conference agreeing to let him in. Most DX chasers deplore any kind of financial list and any rare DX station working to such a list would soon be in dire trouble. Most listeners who had heard the enormous pile up on ZK1MA's fixed frequency would not have fallen into the error of believing that was any financial listing —far from it. The old story of too many chasing too few.

If a rare DX spot is activated it would take it a year every minute of every day at 10 contacts per minute to work the other half million licensed Amateurs in the world. To work every licensed VK station it would take nearly three days without a break at the "leisurely" rate of 100 QSOs per hour! Fortunately, not every Amateur is active, not everyone chases DX and not all are on the h.f. bands, but even so, the phenomenal pile-ups which occur for a rare one must be heard to be believed.

The good operator of the rare station works off his own frequency (much to the annoyance of the transceiver mob) and proceeds to peel off the layers with a professional touch. He wastes no time listening to stations busily calling out his own call sign. If you are in there he assumes you are after him. He likes the quick clear call, your own call sign, just once. This saves time and QRM. To be called in by him and then start telling him about your rig, name, antenna and general rag-chewing aggravate all the other hopefuls in the queue.

Come along now. How about some news? What about c.w.? What about r.t.t.y.? What has happened to our old faithfuls?

☆

FEDERAL AWARDS

COOK BI-CENTENARY AWARD

The following additional stations have qualified for the Award:

Cert. No.	Call	Cert. No.	Call
1356	W9RCJ	1360	W6BDI
1357	WB2JGO	1361	AX2AXL
1358	WB2IEC	1362	PA0KGS/W2
1359	AX3TE	1363	AX3YQ

V.h.f./U.h.f. Section

Cert. No.	Call
28	AX4ZAM

W.I.A. V.H.F.C.C.

New Member:

Cert. No.	Call	Confirmations 52 MHz.	144 MHz.
80	VK4ZIM	594	—

W.I.A. 52 MHz. W.A.S. AWARD

New Member:

Cert. No.	Call	Additional Countries
95	VK5ZKW	1

VHF

Sub-Editor: ERIC JAMIESON, VK5LP
Forreston, South Australia, 5233.
Closing date for copy 30th of month.
All Times in E.S.T.

AMATEUR BAND BEACONS

VK0	53.544	VK0GR Antarctica.
VK3	144.700	VK3VE Vermont.
VK4	144.390	VK4VV 107m. W. of Brisbane.
VK5	53.000	VK5VF Mt. Lofty.
	144.800	VK5VF Mt. Lofty.
VK6	52.006	VK6VF Tuart Hill.
	52.900	VK6TS Carnarvon.
	144.500	VK6VE Mt. Barker.
	145.010	VK6VF Tuart Hill.
	435.000	VK6VF (on by arrangement).
VK7	144.900	VK7VF Devonport.
VK9	144.600	VK9XI Christmas Island.
ZL2	145.200	ZL2VHF Wellington.
ZL3	145.000	ZL3VHF Christchurch.
JA	51.995	JA1IGY Japan.
W	50.091	WB6KAP U.S.A.
HL	50.100	HL9WI South Korea.
ZK	50.100	ZK1AA Cook Island.
KH6	50.101	KH6EQI Hawaii.
	50.015	KH6ERU Hawaii.

No notified changes to beacon list this month although it would appear from a report in the Geelong Amateur Radio Television Club Newsletter that Phil VK0PH (ex VK3FF) is running a beacon on a 24-hour basis on 53.440 MHz. with the keyed c.w. call sign of VK0PH. Phil listens daily on 6 metres between 1900 and 2000 hours.

These notes are being prepared whilst on holidays in Alice Springs in VK8. They may therefore of necessity be incomplete and any correspondence arriving at the end of the month would be excluded from this issue. The weather is great, warm sunny days and cool nights. So far have not tracked down any v.h.f. activity here, but may be able to do so before I leave. At the last minute I decided against taking v.h.f. equipment with me owing to the weight and bulk of the gear required. When one considers the equipment needed would include complete 6 and 2 metre tx's and associated power supplies, converters, rx and at the least two yagi antennas of reasonable size, masts, etc., and these to be transported over 800 miles of generally rough unsealed roads, the task assumes some magnitude, and at this time of the year the chances of any contacts whatever are so remote on either band that it takes the bloom off the whole operation. Therefore I have contented myself with bringing a small compact 40 mx rig lent by John VK5JQ and which has provided some d.s.b. contacts over distances of 1,000 miles from about 10 watts.

METEOR SCATTER

Rod VK2ZQJ sent a further brief note to advise having successfully worked VK4RO on s.s.b. by M/S on 10th June. This came as Rod's reward for diligently sticking to a sked with David VK8AU in Tennant Creek which did not bear fruit. While on the subject of M/S, in a very round-about way from Rob VK3AOT comes news that Wally VK5ZWW has added another State to his score for M/S by working George VK3ASV during June. Congrats. Wally, but what about some notes of your general activity in this direction please.

From the pen of Bob VK3AOT, my most earnest scribe from VK3, comes advice that the first VK3 field day for the coming season will be held to correspond with the VK5 v.h.f. field day on 25th and 26th September. This is welcome news as it may help with general activity. (Incidentally, it is rumoured that the successful winning team of the past three VK5 field days—Bob VK5ZDX and Wally VK5ZWW—are this year splitting up and will be entering as respective contestants; wonder if they will each be using the same site? Bob has indicated that during every field day to be held this year in VK3 he will be operating on 144, 432 and 576 MHz. from Mt. Buangor, near Ararat, with special emphasis on getting through to Tony VK5ZDY on 576, thus taking the 576 MHz. record from John VK5QZ.

Melbourne Channel 1 repeater on f.m. has been shifted from Carlton to Dunn's Hill, near Mt. Dandenong. The service area is now expected to be about 100 miles with the possibility of some enhancement from tropospheric effects. The new site has also improved the coverage of the Melbourne area.

George VK3ASV in Morwell continues to be up at the front in v.h.f. activity and has now successfully transmitted and received Amateur TV to Brian VK3BBB in Traralgon. Peter VK3TR and David VK3ABC, both of Sale, are building a.t.v. gear, while Dave VK3YEC has an excellent closed circuit a.t.v. set-up working, and is currently developing a 432 MHz. tx-rx set-up for a.t.v.

Bob further advises increased activity in Mildura where there are now at least seven stations operating on six metres. This is good news as their activity during band openings in the DX season will give an indication of the shortening of skip conditions, indicative of a rise in the MUF and signifying the possibility of useful 2 mx contacts. Other 6 mx activity of interest includes contact between Kerry VK5SU at Ceduna and VK6ZCM in Perth on 12th June. Leigh VK6WA continues to operate nightly on 52.156 at 1900 and beaming east.

David VK8AU in Tennant Creek sends a letter advising having worked JA0JEC and JR1NP on 12th May. His DX log for May and June should be of interest:

15/5—0630—VK8KK on forward scatter.
16/6—1715—JR1MUZ F2.
22/5—0600—VK8KK forward scatter & M/S.
5/6—0600—VK5ZWW M/S.
0630—VK8KK F/S and M/S.
6/6—0700—VK8KK F/S and M/S.
8/6—0630—VK4RO M/S.
0700—VK5ZWW M/S.
0715—VK5DX M/S.
9/6—0630—VK4RO M/S.
0700—VK5ZDX M/S.
9/6—1830—VK9ZAP Sporadic E.
2055—VK5ZDX M/S.
10/6—0700—VK5ZDX M/S.
11/5—0700—VK5ZDX M/S.

David goes on to say "As you can see, 6 mx is never really shut. The signals from VK-5ZDX were really good, considering the fact he was running 80 watts p.e.p. input and a 6 element yagi. The modis-operandi between Bob and I was to call alternate five minutes using break-in s.s.b. In this way, if a reply was obtained, signal reports could be immediately exchanged. It is remarkable the amount of information that can be exchanged on a five-second burst using this technique. I occasionally hear good bursts from the VK5 beacon VK5VF on 53.000 MHz.

"Present indications are that for very high power stations (5kw. p.e.p. e.r.p.) a maximum range of 1,300 miles is feasible. Signals rapidly improve below this distance to where 300-400w. p.e.p. e.r.p. is useful in the 800 to 1,100 mile region. Below this range, power requirements tend to get more stringent again as we move out of the M/S region into the forward scatter area where pure brute force is necessary. Below 300 miles again, power requirements drop off.

"It is not easy to generate 400 watts. p.e.p. output at 52 MHz. as most linears tend to run at only 50% efficiency once you get above about 30 MHz. Antenna gain figures also tend to be on the optimistic side too, and feedline losses are ALWAYS more than quoted. VK8KK and I both use heliax on our 6 mx antennae." Thanks David for your letter and the interesting observations contained therein.

144 MHz. BAND PLAN

The following information has been supplied by George VK3ASV of Morwell and is a **band zoning report** by the Eastern Zone of VK3. It is submitted for the interest of all those concerned with 144 MHz. activity in particular. Being in Alice Springs at the moment and with a shortage of other news, it seems an appropriate time to give this information an airing. Your thoughts on the matter would be gratefully received by me, and if of sufficient general interest could be included in "Amateur Radio" for others to consider.

"The Eastern Zone last year set up a group to study a 144 MHz. band plan or segment, results outlined and discussed at recent general meetings on 19th Sept., 5th Dec., 1970, and 28th Feb., 1971. This plan has now started to take shape (March 1971).

"In the report the group recommendation is that Eastern Zone 2 mx stations will transmit on spot frequencies between 144.406 and 144.496 MHz., thus 16 working channels at 6 KHz. separation. This decision should not be too restrictive on the individual operator, he may still v.f.o. off his working frequency outside the zone segment to net on or to work Es, rare DX or c.w., and special modes such as moonbounce, meteor scatter, aurora, back scatter and/or record attempts, etc.

"First consideration, is band planning necessary? If so, we would have to consider New Zealand as they are currently considering the same thing. Also, near-by countries in case of in-band translators on orbiting or stationary (sync.) satellites. Should we have a conference at Federal or National level to formulate such a plan?

"In drawing up a plan, thought would have to be given to existing services as well as future ideas, covering:—

144.000 to 144.1—C.w. and DX, international moonbounce experiments, aurora and back scatter.
144.1 to 144.5—Free operation, perhaps with some zoning for regions.
144.5—National a.m. mobile net frequency.
144.5 to 145.0—DX and experimental beacons.
145.0 to 147.0—F.m. simplex nets (national 146.0), repeaters and translators (linear and hard limiting).
147.0 to 148.0—Experimental cross-band translators.

"The rest of the band not specifically allocated, this being a testing area. Note in New Zealand, 144.65 to 147.75 is used as civil defence and A.R.E.C. nets similar to our W.I.C.E.N., leaving the upper portion for free operation except during emergencies. We should therefore use this portion if we don't want to lose it to commercial land-mobile radio-telephone services.

"Finally, the a.m./s.s.b. or lower portion could be further divided regionally where necessary. England has had this for 20 years, in which the whole country followed a band plan supported by the v.h.f. committee of the R.S.G.B. Their plan was reviewed and simplified into four zones 12 months ago. Here in Australia and New Zealand this sounds attractive until one considers the impractibility of having large unused portions in most areas with the possibility that where there is a large population density it would be overcrowded. In a small state like Victoria such a zone plan can be commonsense."

— . . . —

REPEATER NEWS

A new F.R.S. report was prepared during June and sent to those who received the first issue report released during February. Anybody who would like a copy of the report may obtain one by writing to the Federal Repeater Secretariat, P.O. Box 342, Crows Nest, N.S.W., 2065.

It has been announced that the proposed beacons for Sydney will be installed at VK2WI Dural and will operate on 52.2 and 144.2 MHz.; a 6 metre beacon for Townsville (VK4) will operate on 52.4 MHz. when licensed.

New Zealand has been working on a 2 metre band plan for the country. In the draft plan we received, they have made provision for all modes of operation. There are f.m. simplex channels every 50 KHz. from 145.8 to 146.2 MHz. with 145.85, 146.0 and 146.15 MHz. as the prime channels. 146.0 MHz. to be first. On the f.m. repeater side they have allocated four channels on 700 KHz. spacing. A pity, as it does not make them compatible to Australia. Inputs on 146.3, .35, .4 and .45 with the outputs on 145.6, .65, .7 and .75. The three-channel a.m. repeater systems have inputs on 144.6, .65 and .7 with the outputs on 145.725, .775 and .825. 144.8 MHz. is set aside as a r.t.t.y. net frequency. The beacons are on the "hundred" equal to the call area, e.g. ZL1 on 145.1, ZL2 on 145.2, ZL3 on 145.3, and ZL4 on 145.4 MHz. The segment 144.0 to 144.1 MHz. is set aside as DX and experimental working. 144.1 to 144.5 MHz. is a general working segment.

Our thanks to the various groups who have completed and returned the recent questionnaire which will enable us to up-date our records.

The American magazines ("73" in particular) have stepped up f.m. articles and advertising in their recent issues. F.m. has really arrived in the U.S.A. In a recent issue of one magazine you can even buy a complete ready-to-go Amateur repeater which is commercially made. There have been plenty of articles in all the issues. There is a good short article in the March 1971 issue of "Ham Radio" by VE7ABK entitled "Plain Talk About Repeater Problems". It deals with intermodulation and desensitisation and discusses some of the solutions. In the ads., with the increasing number of local and Japanese f.m. transceivers being offered for sale, competition is forcing many of them to be fitted with several crystals on the major national frequencies. Also being offered for sale are continuously scanning monitor receivers for watching all the repeater channels in an area.

The May issue of Region 1 I.A.R.U. news lists some 18 two metre f.m. repeaters operating in Germany. Most of them are on 144.15 MHz. in and 145.85 MHz. out, with tone calling for access. There is also a list of some 63 beacon stations in Region 1 on the 14, 28, 50, 70, 144 and 432 MHz. bands.

Note.—The details on page 13 of June "A.R." under the heading Project Australis will require revision according to the latest information to hand.

—Federal Repeater Secretariat.

W.I.A. D.X.C.C.

Listed below are the highest twelve members in each section. Position in the list is determined by the first number shown. The first number represents the participant's total countries less any credits given for deleted countries. The second number shown represents the total D.X.C.C. credits given, including deleted countries. Where totals are the same, listings will be alphabetical by call sign.

Credits for new members and those whose totals have been amended are also shown.

PHONE

VK5MS	319/343	VK2APK	288/295
VK6RU	316/342	VK4FJ	286/307
VK3AHO	310/326	VK4TY	284/288
VK4KS	307/322	VK4UC	278/278
VK6MK	303/324	VK2AAK	274/279
VK5AB	296/314	VK3ZE	273/270

Amendments:

VK3TL	270/277	VK4RF	213/213
VK3JW	250/251	VK3TD	180/184
VK3AMK	232/232	VK4FH	165/172
VK2AHH	218/228	VK4SD	123/124

C.W.

VK2QL	303/326	VK3NC	273/300
VK3AHQ	300/315	VK3XB	270/287
VK4FJ	289/315	VK3ARX	270/279
VK3YL	286/303	VK6RU	266/289
VK2APK	284/292	VK4TY	259/272
VK2AGH	282/296	VK3TL	255/260

New Member:

Cert. No.	Call	Total
97	VK4FH	100/105

Amendments:

VK3RJ	248/262	VK2AHH	137/145
VK4RF	188/200		

OPEN

VK6RU	317/343	VK6MK	303/324
VK4SD	315/330	VK2APK	302/314
VK2AGH	314/334	VK2EO	301/325
VK2VN	309/328	VK3ARX	299/308
VK4KS	308/327	VK4UC	298/298
VK4TY	306/321	VK4FJ	297/323

New Members:

Cert. No.	Call	Total
134	VK5EJ	107/108
135	VK3LV	102/102

Amendments:

VK3TL	286/293	VK2AHH	234/248
VK3NC	274/298	VK4FH	187/196
VK4RF	251/263		

SILENT KEYS

It is with deep regret that we record the passing of—

VK2NP—C. F. L. Fryar
VK3VX—A. G. Pither.
VK6XG—C. W. C. Sirl.
VK7ML—M. L. Loveless.

HAMADS

Minimum $1 for forty words
Extra words, 3 cents each

HAMADS WILL NOT BE PUBLISHED UNLESS ACCOMPANIED BY REMITTANCE

Advertisements under this heading will be accepted only from Amateurs and S.w.l's. The Publishers reserve the right to reject any advertising which, in their opinion, is of a commercial nature. Copy must be received at **P.O. 36, East Melbourne, Vic., 3002**, by **5th of the month** and **remittance must accompany** the advertisement.

ANTENNA for Sale: Ten element widespaced Yagi on two metres, on fifty foot rotable mast (Hills type), whose guys consist of 80, 40, 20 metre dipoles. Plus all feed lines and co-ax. Prefer not to separate. The lot for $30. John Storey, VK3AQO, Zig Zag Rd., Eltham, Vic. Ph. 439-8804.

FOR SALE: A.m. Pye Bantam, all transistorised portable, output ½w., suitable for 52 or 144 MHz. Excellent condition with leather case and mike, $80. VK5ZEI, 24 Seafield Ave., Kingswood, S.A. Phone 7-4671.

FOR SALE: Antenna Rotator—Stolle rotator; the rotator with the transistorised, automatic control unit. The gear box has been modified and strengthened by the replacement of the die-cast teeth of the final output wheel by a hardened mild steel ring gear securely bolted to the body of the wheel. Accurately meshes with the final worm drive. Beautiful job by a skilled machinist. Rotator now ideally suited for quad, X beam or even larger antennas. Price $40 o.n.o. VK7KB, Darling St., Port Sorell, Tas. Phone 28-6133.

FOR SALE: Complete s.s.b. station including: Heath SB101 Transceiver $380, Heath SB640 external v.f.o. $100, Heath SB600 loudspeaker $20, extra heavy duty power supply $85. Will accept $550 for the complete outfit, but I am not interested in offers at these bargain prices. The equipment is as new and can be viewed in operation by appointment. Phone T. Dineen VK3TD Melb. 783-9611 or 787-1407 A.H. or write C/o. P.O. Box 256, Frankston Vic.

FOR SALE: Dummy load. Heath HN31 50 ohm non-inductive dummy load. Has diode rectifier and filter to measure power output with a standard multimeter. In can, filled with 1 gallon of transformer oil. Price $15. VK7KB, I. R. Pearson, Darling St., Port Sorell, Tas. Phone 28-6133.

FOR SALE: Estate late Dale West, VK4EJ. Trio Transceiver type TS510 with crystal calibrator. Matching Power Supply type PS510. Instruction booklets for both units. Dynamic Microphone DM10. $380 the lot or nearest offer. Contact VK4IK, 6 Cassia St., Edgehill, Cairns, Qld. Ph. 070-53-2082.

FOR SALE: Hallicrafters SX-117 triple conversion Receiver and Hallicrafters HT44 Transmitter. Matching pair. Will transceive. All modes. All facilities. Complete station, with manuals. Transceive and all other cables, power supply, speaker and 500w. 110 volt transformer. $495 o.n.o. R. Vickary, VK4VX, 20 Inglis St., Grange, Qld., 4051.

FOR SALE: Hills heavy duty three-section Telescopic Tower, 72 ft., three sets guys, turnbuckles, etc., top set insulated for 40 mx and 80 mx inverted vees. TH6DX Tribander, BN-86 Balun, TR-44 Rotator with supporting cage, co-axial and control cables, $495. Webster Bandspanner $30. VK2AQW, 24 Ramsay Ave., West Pymble, N.S.W., Phone 449-3538.

FOR SALE: K.W. Vespa Mk. I., s.s.b./c.w./a.m., 90w. p.e.p., 160-10 mx, tx and h.b. p.s.u. $180. Lafayette HA500 Rx, a.m., bands 80-6 mx, xtal cal., $85. Both $260. Codar AT5 a.m./c.w. Tx (8 x 5 x 4 in.), 14w. i./p., 160-80-40 mx, 240v. a.c. p.s.u./c.u. 12v. d.c. p.s.u., remote c.u., s.w.r. mtr./dummy load, a.t.u., r.f. meter, $80. Tavasu Mobile Whip Ant., 160-10 mx, $25. Full specs. on receipt s.a.e. VK7MT, 186 Punch Bowl Rd., Launceston, Tas., 7250. Phone 44-1392.

FOR SALE: Pye Mk. 3 Transceiver, 53.032 MHz., complete, 240v. a.c. operation, $35. Also, h.b. A.R.R.L. Linear Amplifier, 80-10 mx, capable of 1 kw. p.e.p., forced-air cooled, g.g. parallel 4-400As, fully metered and safety protected, $200. Contact R. Wyllie, VK3BBZ, Ph. 399-1311 ext. 454, or 12 Balmoral St., Laverton, Vic., 3027, a.h.

FOR SALE: Pye Mobile Communication System (30 KHz.), Model PTCA 8750 (A.R.O.) For inspection contact Mr. Rogers, Ph. 69-0220. Michaelis Bayley, 150 Buckhurst St., South Melbourne, Vic.

FOR SALE: Yaesu FT2F, new, with Channels A, B, C, R1 and R3 xtals, $195. MR20 2-Channel Tx-Rx with a.c. supply for base use, no xtals, $45. Creed Tape Distributor 6S5, $50. Phone 437-1811 (Melb.), VK3IZ.

FOR SALE: Yaesu Musen Transceiver FT200. A1 condtiion electrical and mechanical. Original packing box. $320. K. Hoffmann, 10 Druce St., Toowoomba, Qld., 4350.

FOR SALE: 67 ft. Galvanised Telescopic Wind-up Tower, comp. with TH3 Mk. 2 Beam and rotator motor control unit, TH3 balun co-ax., motor feeder, etc. Guides and rigging incorporating balun-fed 80-40 mx Inverted Vee Ant. with separate co-ax. feeder. Complete coverage 10-15-20-40-80 metres. Phone Gosford 411903, VK2NI, or write A. B. Nyhuis, 240 Burge Rd., Woy Woy, N.S.W., 2256.

FOR SALE: 240 watt SSB Transceiver, 20/40/80 mx. $175.00. 900v. Power Supply for same, $85.00 Microphone, $10.00. Folded Dipole Antennas, with 300 ohm feeders, $10.00 and $15.00. 300 ohms to 75 ohms low-loss Baluns, $1.00. HRO-060 Communications Receiver, 1.7 to 30 MHz., SSB/AM/CW, as new, $495.00. Swap new 807s for two new 6V6GTs and one 6SN7. VK3TD, C/o. P.O. Box 256, Frankston, Vic. Phone Melb. 787-1407 A.H.

SELL: Vibroplex "Vibro-Keyer" plus professionally wired U.S.A. manufactured Digi-Keyer. Both used few hours. Selling at landed cost, $40. Bargain for discriminating c.w. operator. Also six volumes professionally bound "QST" 1968, 1969 and 1970, $30. Roth Jones, 1 Albert Road, Melbourne, Vic., 3004.

SWAN 500 Transceiver, home brew heavy duty Power Supply, vox, mic., $470. Noel L. Martin, Wallace St., Bell, Qld., 4408.

WANTED: Band-change motors and L-R indicator drive transformers to suit 24 volt Bendix MN26 Radio Compass sets. Transformers are marked T16 or A15064. State price required. Also Vintage Radios complete with Horn Speaker, early 1920's, good price paid, send details. O'Brien, Edgar Rd., San Remo, Vic., 3925. Phone 107.

WANTED.—Galaxy V. DC, DC power supply and mobile mount. Power required, 800v. DC at 400 mA. 10% regulation, 350v. DC at 200 mA. 10% regulation, negative 100v. DC at 35 mA. G. Howard, VK3XD, Eltham North, Vic., 3095. Ph. 439-9862.